March
1933

Construction Methods

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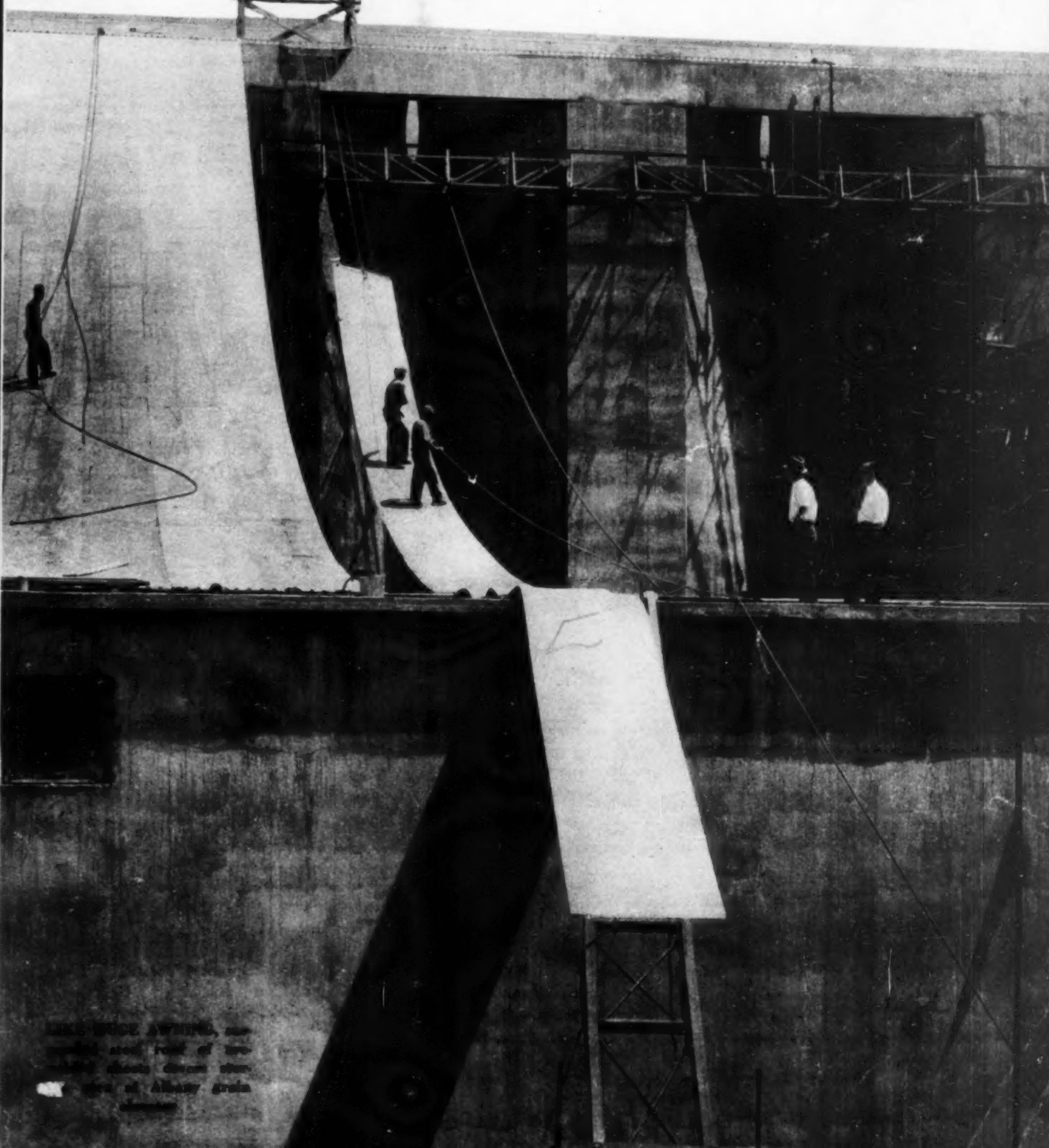

This Month

MADDEN DAM in Canal Zone has improved construction cableway and concrete plant of modern design.

MELTING ICE, instead of jacks, lowers bridge span.

"RENOVIZE" campaign creates jobs for unemployed in Philadelphia.

HOOVER DAM progress, as observed by J. I. Ballard, of "Construction Methods" staff.

SUSPENDED STEEL ROOFS of novel arc-welded design cover storage areas at big Albany grain elevator.

COST KEEPING and records—sixth of the series of articles on successful contracting by Harry O. Locher.

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6% to 20% SAVED ON GASOLENE

POWER PROVER cuts fuel costs on 6 types of gasolene-driven equipment for Yeo Construction Co., Inc.

POWER PROVER service has been a part of the maintenance routine of Yeo Construction Co., Inc., of Philadelphia only a few weeks—but here is the report on estimated gasolene savings and other improvements:

- 13% on 10 Trucks
- 18% on 2 Rollers
- 11% on 3 Concrete Mixers
- 6% on 2 Gasolene Pumps
- 15% on 2 Cranes
- 20% on 2 Wood Saws

Power was increased and performance improved on all vehicles.

These figures are based on the increase in engine efficiency resulting from Power Proving, and a subsequent period of actual service.

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Construction Methods

McGraw-Hill Publishing Company, Inc., 330 West 42nd St., New York
Robert K. Tomlin, Editor
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John W. Shaver (Cleveland), Nelle Fitzgerald
Willard Chevalier, Publishing Director

Suspended Roof of Welded Plate

Suspended, self-supporting steel-plate roofs of the Albany grain elevator, described elsewhere in this issue, represent a great advance over previous designs of the suspension type. At Albany, each all-welded steel sheet, hanging in a sloping curve between anchorages at two elevations, performs the double function of covering the area beneath and of supporting all roof loads. Apparently the nearest previous approach to this design, and perhaps its progenitor, was the suspended roof on a grain elevator erected at Omaha in 1930. The earlier design employed steel suspension cables to carry corrugated iron roofing, which rested on purlins attached to the cables. By eliminating the auxiliary supporting system, the designers of the Albany elevator reduced the roof to its indispensable elements.

For buildings adapted to its use, the suspended roof offers distinct advantages in construction economy and unobstructed floor space. These advantages are important enough to encourage a belief that the suspended roof design will be applied to structures erected for other purposes than grain storage. After the demonstration of rapid and skillful erection at Albany, there can be no doubt of the roof's practicability, from the construction angle. A slow and awkward method of erection on the first installation would have made the roof construction appear difficult and costly. By holding construction time and costs to a minimum, the erectors aided early and accurate evaluation of the suspended roof as a design element.

Priming the Pump

FOR the relief of unemployment United States Senator Robert F. Wagner, of New York, has been a consistent advocate of a large scale program of public works construction. In connection with the Senate Finance Committee's hearings at Washington last month, he stated the case clearly and tersely in these words:

"If public construction is to succeed in achieving the hopes of its advocates, it must be conducted on a large scale. If the business machine is actually to be started, it is essential that a program large enough to give employment to at least several million men be begun without delay.

"A pump cannot be primed with an eye-dropper. Neither can the business pump be primed with minute injections of occasional public works projects."

Senator Wagner's estimate of the present situation is forcefully dramatized in the cartoon, "Priming the Pump," by Enright, reproduced below from the *New York American*.

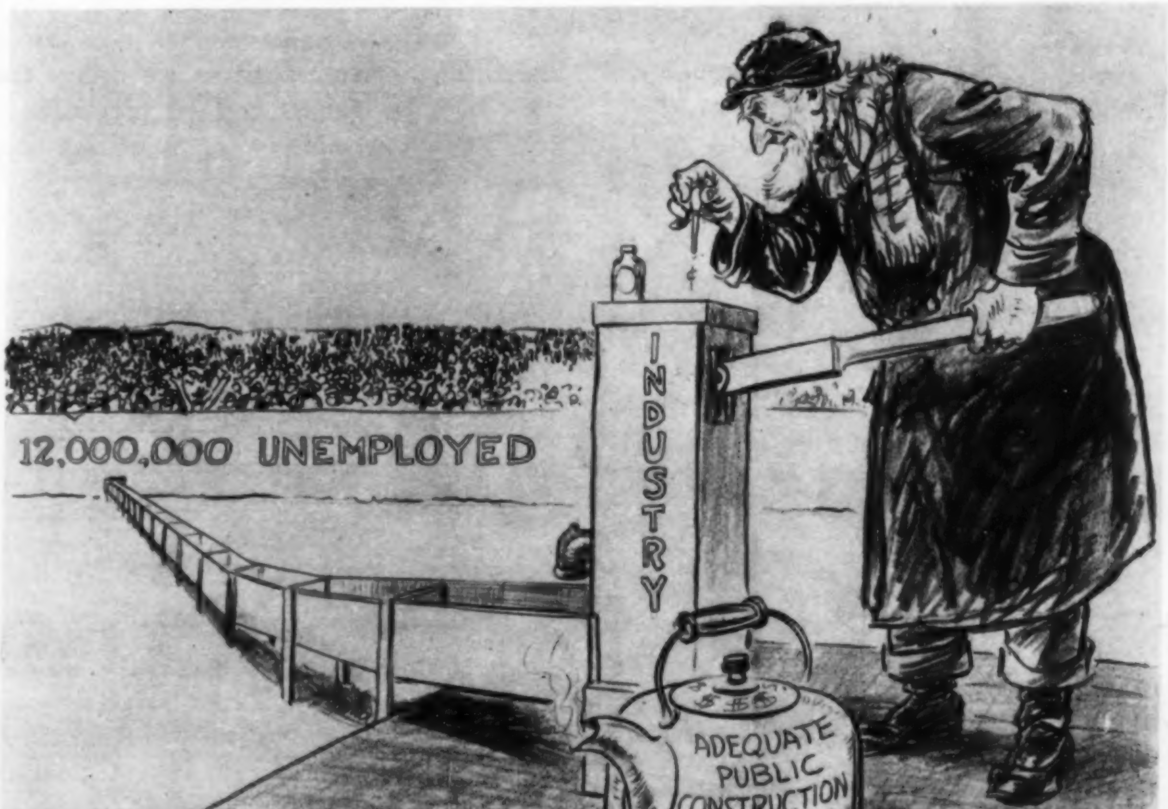
It is suggestive of the pathetic inadequacy of the Reconstruction Finance Corporation's loans for self-liquidating construction projects. Of a total of $1,500,000,000 authorized in this category by the Relief Act last July, approval has been given to applications covering only $172,206,000, of which the "eye-dropper" sum of about $22,000,000 has actually been put to work to create jobs.

To Obtain Unemployment Relief

Correspondence received by the Engineer's National Relief Committee indicates that many unemployed engineers throughout the United States are unaware that various forms of relief are available in their own communities. Practically every state, county and city has raised or appropriated funds to provide for the relief of the unemployed. These funds are being expended in various ways.

Experience during recent months indicates, according to a statement just issued by the American Society of Civil Engineers, that all engineers out of work and in need of assistance should first acquaint themselves with the local method of providing relief. This may be done by getting in touch with any of the following persons in their community: (1) Officers of local sections of national engineering societies; (2) officers of local engineering clubs; (3) the city engineer; (4) the county engineer.

If the individual is so located as to be unable to reach any of the persons mentioned, a letter to the Secretary of the American Society of Civil Engineers, 33 West 39th St., New York, will bring suggestions as to what seems to be the next best procedure.



On Which Payroll?

ALL over the land business men have been trying to make ends meet. With shrinking revenues they have had to cut expenses. To this end they have dropped thousands from their payrolls.

Some that are laid off have savings; others will live for a time on the savings of less unfortunate relatives. But many must rely on direct relief—public or private. This means simply that they will go on the public payroll.

There are two varieties of public payroll. One of them demands value for the expenditure; the other does not. One converts the expenditure into some form of community wealth or service; the other does not. One conserves the taxpayer's contribution as an asset; the other makes of it a liability—that most pathetic of all liabilities, human souls dependent on charity. One creates employment, maintains self-respect, inspires courage and hope. The other fosters idleness, demoralizes and saps the very qualities that have made our country great.

One is the public-works payroll; the other is the dole payroll.

We all are aware that in some cases direct relief is unavoidable, that we cannot possibly employ on public construction all those now out of work. But we know equally well that in the worship of their financial dogma, some of our advisors forget that there is a moral as well as a money factor in this problem of unemployment. So they have sought consistently to sell us the doctrine of "millions for charity but not one cent for employment."

BUT let us get this straight. No matter how we tighten our belts, lower the general standard of living and curtail productive public expenditure, the fact remains that when private business throws men out of work on so vast a scale, the public payroll is bound to absorb a relatively larger share of the general income. The business men, the taxpayer and the employed worker must meet all the payrolls—public and private. Dole dollars do not grow on trees.

The real question is, therefore: On which of the two public payrolls should we prefer to carry our fellow-workers when private business no longer wants them? On the productive or on the destructive payrolls?

Some advocates of governmental economy have broadcast the impression that no public payroll is productive. This of course is pure hokum. The fact is that a water-works or a sewerage plant is exactly as "productive" as a privately-owned electric-light plant or a telephone exchange. All render a service to the public, all collect payment for it, whether as taxes, rates or tolls. A highway from New York to Washington is just as "productive" as a privately-owned railroad between the same cities. Both render transportation service, both collect payment for it as registration fees, gas taxes, freight charges or passenger fares. The payments, moreover, come from exactly the same pocket whether the payer be classed for the moment as taxpayer, shipper, passenger or motorist.

In the construction and operation of both highway and railroad, employment is given to the same kind of men and women in mines, quarries, mills, shops, filling-stations, garages and offices. Yet a project to electrify the railroad is hailed as a contribution to the general welfare while improvement of the highways is deplored as an additional burden on the taxpayer. Why?

WE believe that the administrative costs of government should be cut to the bone in keeping with conditions in private business. This should be effected by reorganization and simplification, by eliminating indefensible bounties to privileged groups and by cutting the salaries of office-holders and employees in line with general business practice. Such cuts are true savings.

But when the public payroll **must** absorb those laid off by private business we believe that they should go, so far as may be practicable, on the productive payroll. We see no sense or reason in slashing our normal programs of highway and other public works construction only to throw those productively employed over to the dole payroll.

Let us beware in these trying times lest we fasten on our people a psychology of the dole that eventually might cost us our national birthright.

Willard Chevalier

Publishing Director

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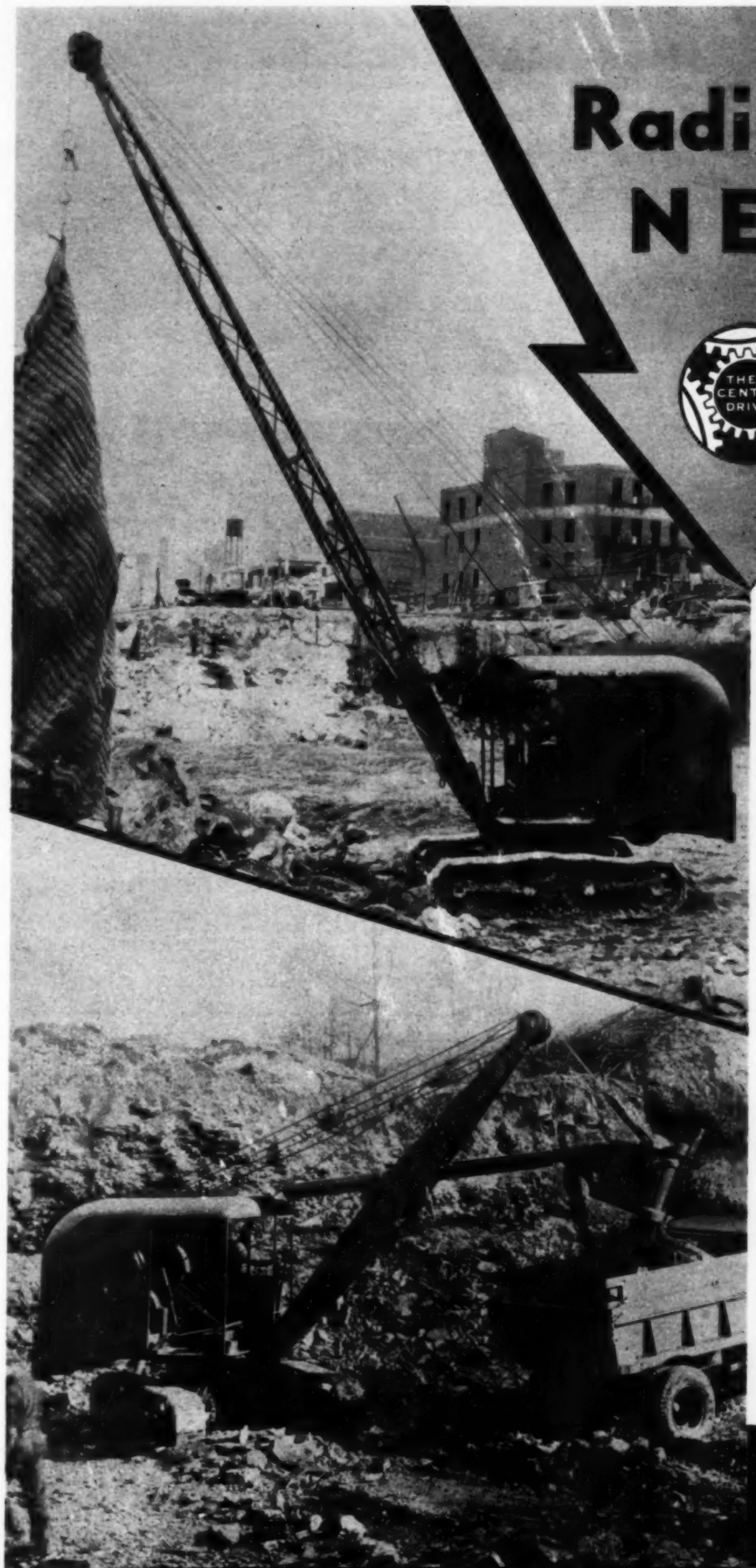

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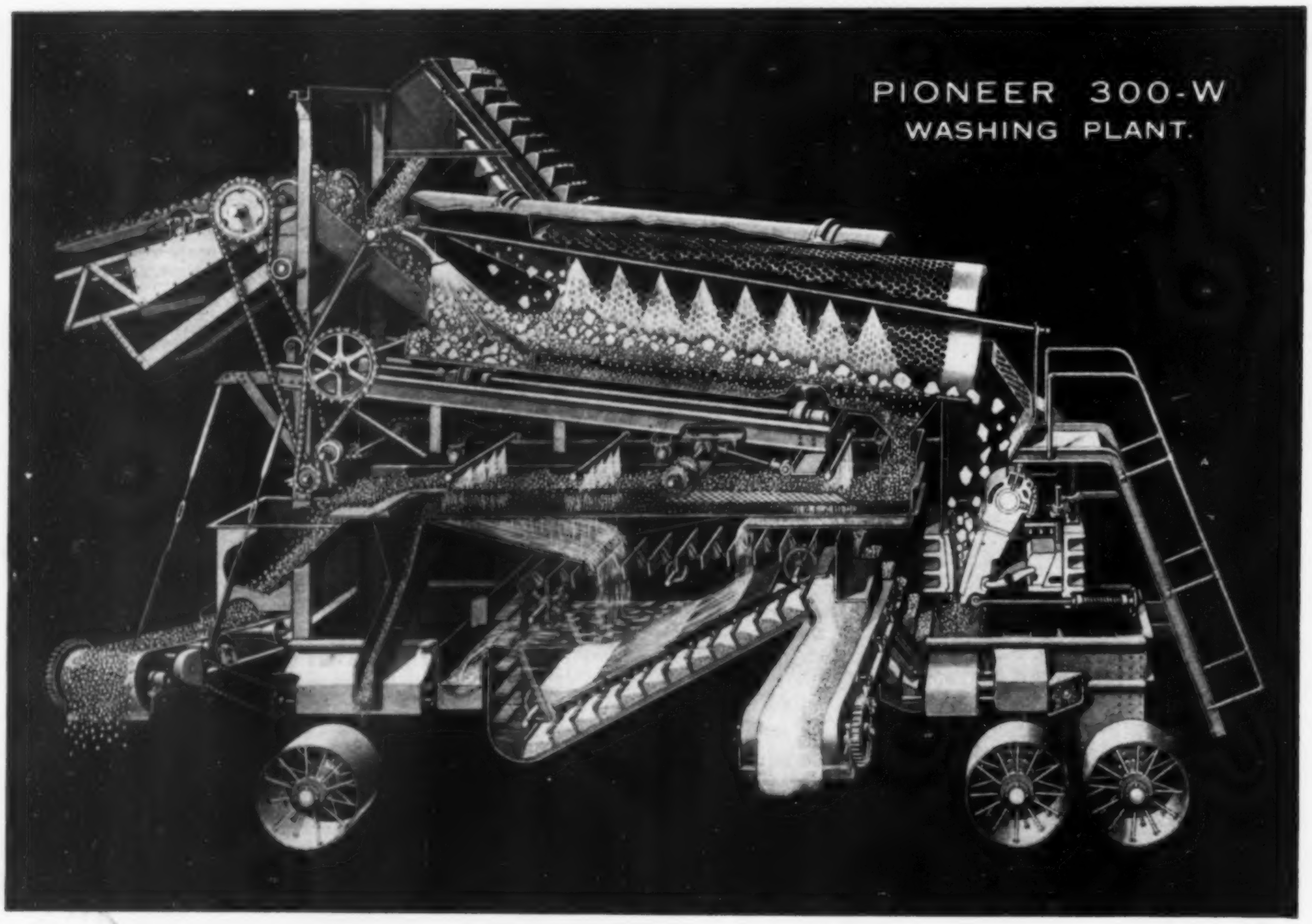

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To Get a HARD FINISH Concrete Floor

Scaling or dusting of concrete floors is out of date. It just won't happen if the topping mix is right. Here's the modern way to make a topping that will produce the floor the owner wants:

FIRST: Put two parts of coarse aggregate (1/8″ to 3/8″ size) in your topping mix, with one part portland cement and one part coarse-grain sand.

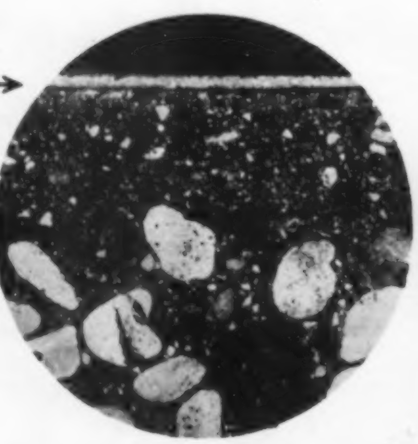
SECOND: Go easy on mixing water—not more than 5 gallons per sack.

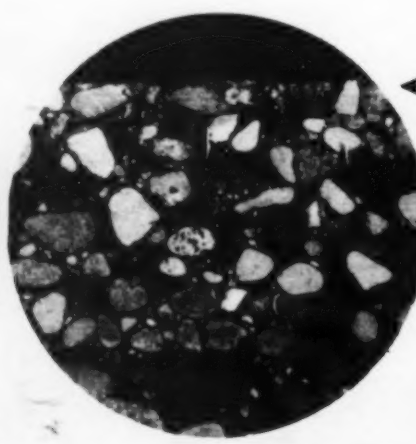
THIRD: Float at once, but don't steel trowel until absolutely necessary (under average conditions, 30 to 40 minutes). Trowel only enough to produce a true, even surface. When hard, cure under wet cover.

That's all there is to it—and the right way usually costs no more than the old-fashioned way. Write the Portland Cement Association if you want more information. It's yours—for the asking.

Wrong

See that white line? It's a "dust on" type of finish, too soft, too porous to stand the gaff of wear. Picture shows a cross-section cut from a slab that crazed in ten days after finishing.





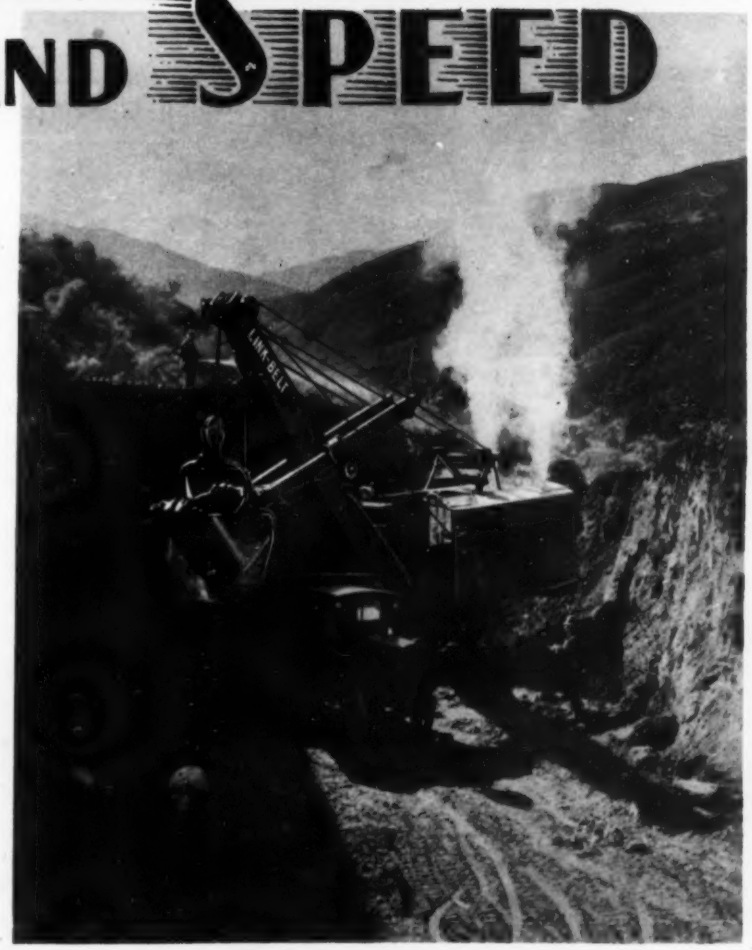
Right.

See the coarse material in the surface of this section? This is the kind of concrete floor that gives lasting satisfaction. Yet it is simple to lay and ordinarily costs no more than the old-fashioned method.

PORTLAND CEMENT ASSOCIATION

33 WEST GRAND AVENUE, CHICAGO ★ CONCRETE FOR PERMANENCE

POWER AND SPEED



POWER is essential to speed in shovel-crane-dragline work. Without ample power it is not possible to have generous speeds, unless the ability to do anything but the very lightest kind of work, is sacrificed. You cannot get more out of a piece of equipment than the energy or power put into it.

Speed is an inherent characteristic of the Link-Belt shovel-crane-dragline, because it is so generously powered.

The performance records of the Link-Belt shovel-crane-dragline have not only proved its uniformly high rate of output, but above all its THOROUGH RELIABILITY and economy in operation and maintenance. From ¾ to 2½ yds. capacity, heavy-duty built.

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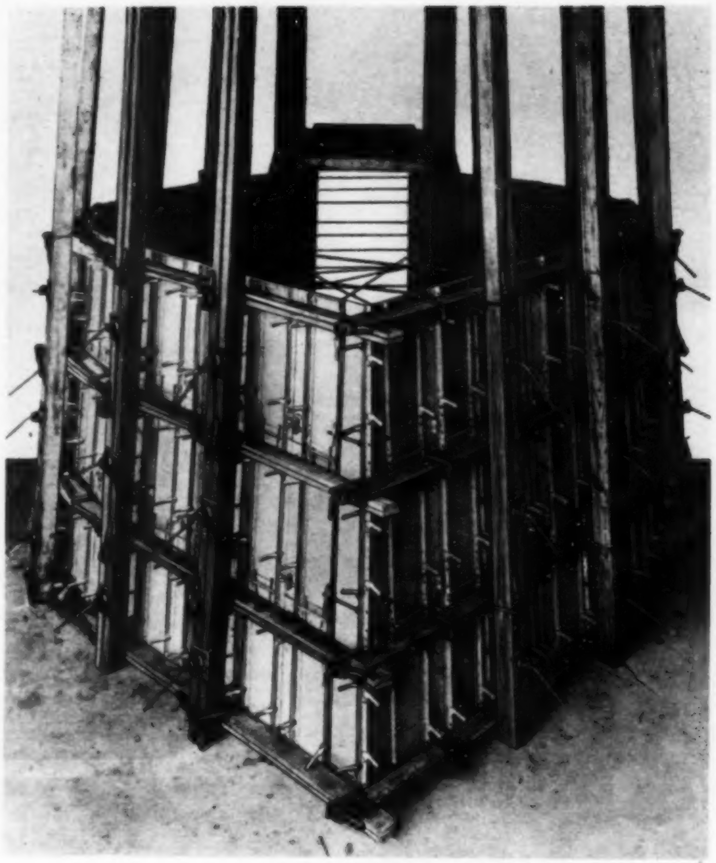


You Can SAVE...with Metaforms

Here is the form for a designed pier and pier-head now under construction.

This form was built by assembling regular standard Metaform units such as any general contractor would use on an average concrete project. Nothing special about these units.

The batter on the pier-head form was made by using adjustable Metaform units pulled in at their tops. The rounded swell at the pier-head sides was built up with narrow fractional units, and the pier body with regular standard Metaforms.

So much less time was required to assemble the Metaforms for this pier with its specially designed head, than would have been required with wood, that the saving itself paid for considerable Metaform equipment.

Under present conditions only the most efficient equipment makes a real profit possible. It is safer to use Metaforms for concrete construction.

If you work with concrete, ask for full information about Metaforms.

Metal Forms Corporation
Milwaukee, Wis.

SAVE *with* Metaforms

Construction Methods

ROBERT K. TOMLIN, Editor

Established 1919—McGraw-Hill Publishing Company, Inc.

Volume 15—Number 3—New York, March, 1933

MELTING ICE CAKES

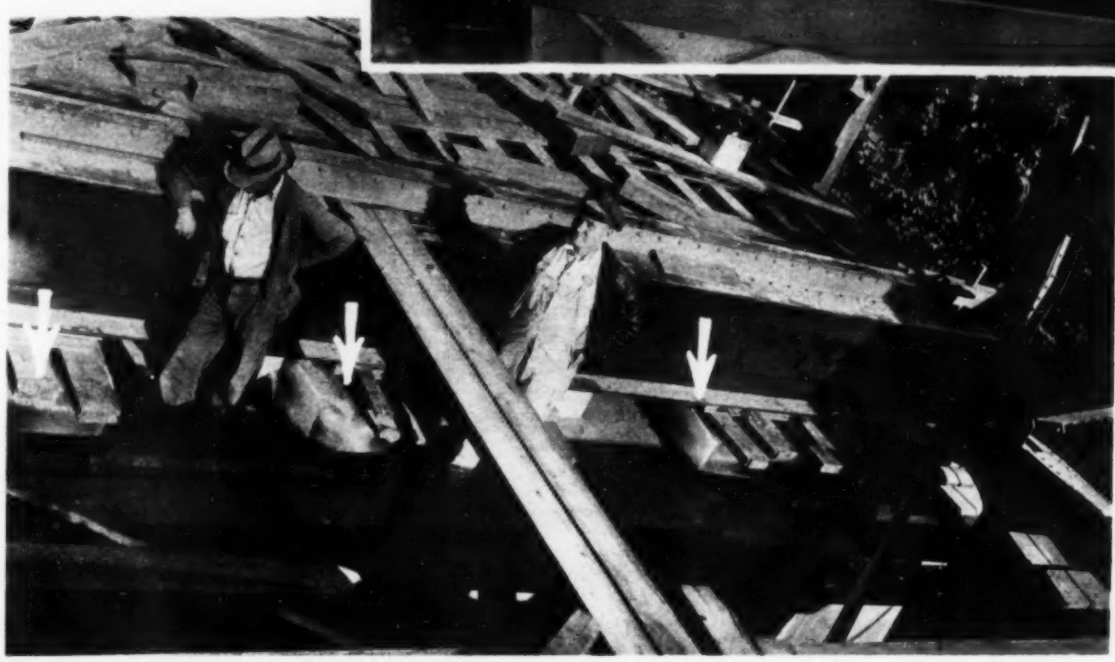
Lower Steel Span on to Piers

SIX 400-lb. cakes of ice took the place of jacks in lowering to final position on its piers a 61-ton through truss bridge across the Russian River on the Tahoe-Ukiah cutoff of the California Division of Highways. Ordinary jacking equipment lowered the steel span from its temporary position on falsework, 3½ ft. above the piers, to within 6 in. of the bearings. At this point the remaining clearance between the bridge beams and the piers proved too short to permit continued use of jacks.

Ice cakes accordingly were substituted, three 10½x21x56-in. cakes being laid in flat position on the concrete pier under each of the end floor beams. After placing timber planks on the ice to distribute the load from the relatively narrow beam flanges over a larger area, workmen lowered the span on to the ice cakes and removed the jacks. The ice melted slowly, taking 25 hr. to lower the bridge the required 6 in. This slow melting gave the workmen ample time to place steel pedestals and rockers and drive 5-in. steel pins.

SIXTY-TON SPAN over Russian River rests on concrete piers after supporting blocks of ice have melted.

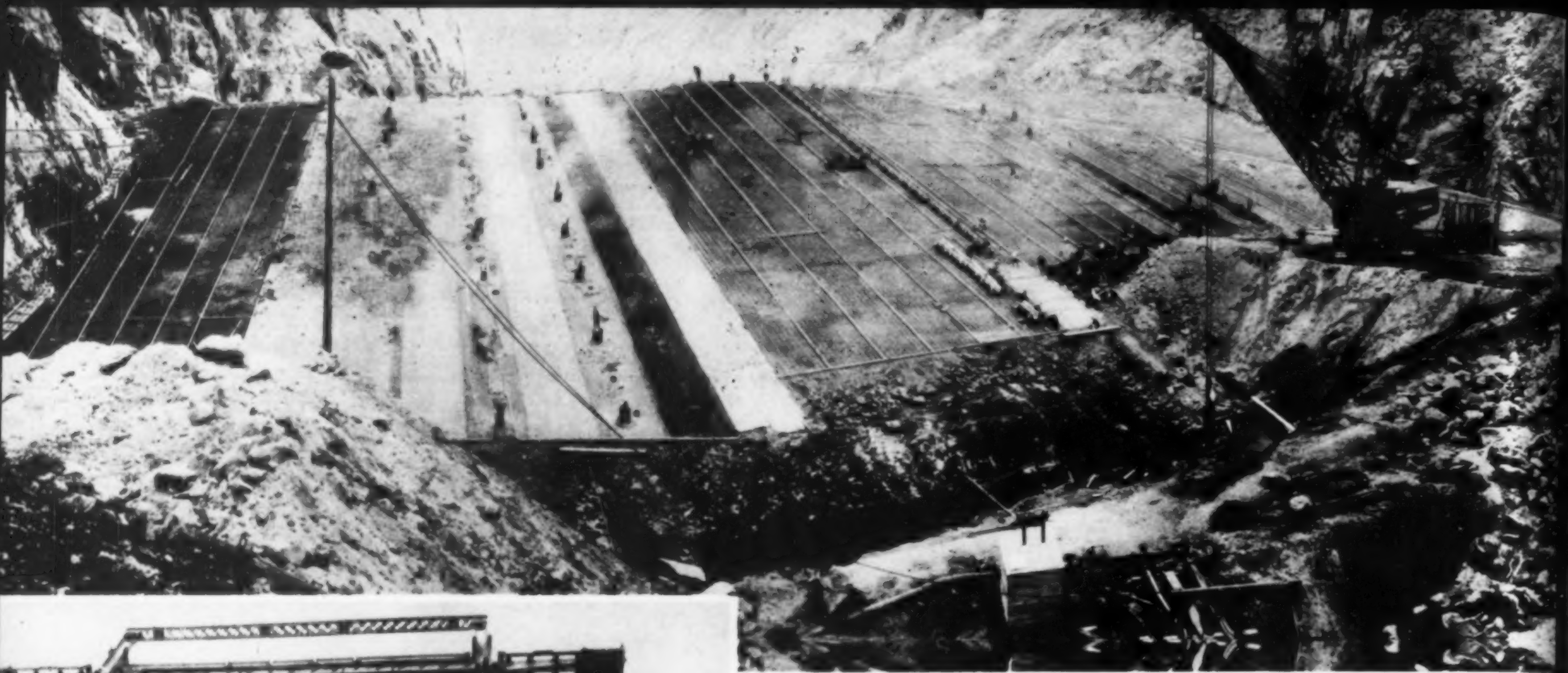
ICE BLOCKS *(right)*, substituted for jacks in lowering bridge to place, weigh 400 lb. and measure 10½ x 21 x 56 in.



TO DISTRIBUTE LOAD of bridge span on six cakes of ice (three for each pier, as indicated by arrows), timber planking is placed under narrow bottom flanges of steel beams.

Each 400-lb. cake of ice supported about 20,000 lb. Tests on 8-in. cubes in the Division of Highways laboratory showed that the ultimate compressive strength of ordinary commercial ice is 220 lb. per square inch. These tests would indicate that the total permissible safe load on the large surface of a 400-lb. cake, using a safety factor of two, is about 130,000 lb. Allowance must be made, however, for the decrease in area as the ice melts. According to the estimate of Gordon L. Long, resident bridge engineer on the project, the three dimensions of the cake appeared to decrease in equal proportion. On this basis, the load had reached almost the permissible safe limit by the time the bridge was lowered to final position. To lower an equal weight through a greater distance would require a larger initial supporting area to allow for the greater decrease.

Preliminary field fabrication on the Russian River bridge project consisted of connecting the two trusses to each other in three sections with transverse floor beams and of moving sections forward individually on to the temporary pile falsework for final joining.

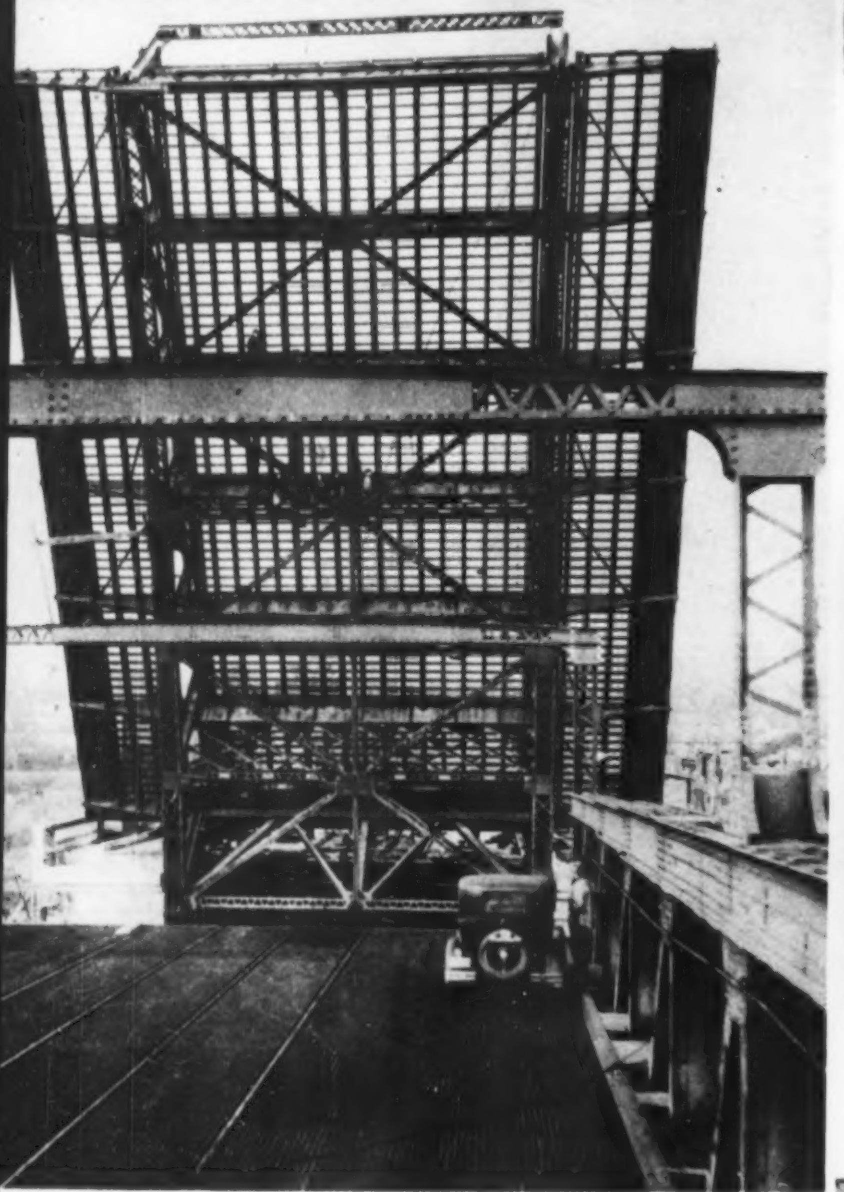


UPSTREAM COFFERDAM for Hoover dam is nearing completion across Colorado River. Fill 80 ft. high, containing 750,000 cu.yd. of earth and rock, has been placed and slope is being paved with concrete by Six Companies Inc. for U. S. Bureau of Reclamation.

This Month's "NEWS REEL"

Wide World

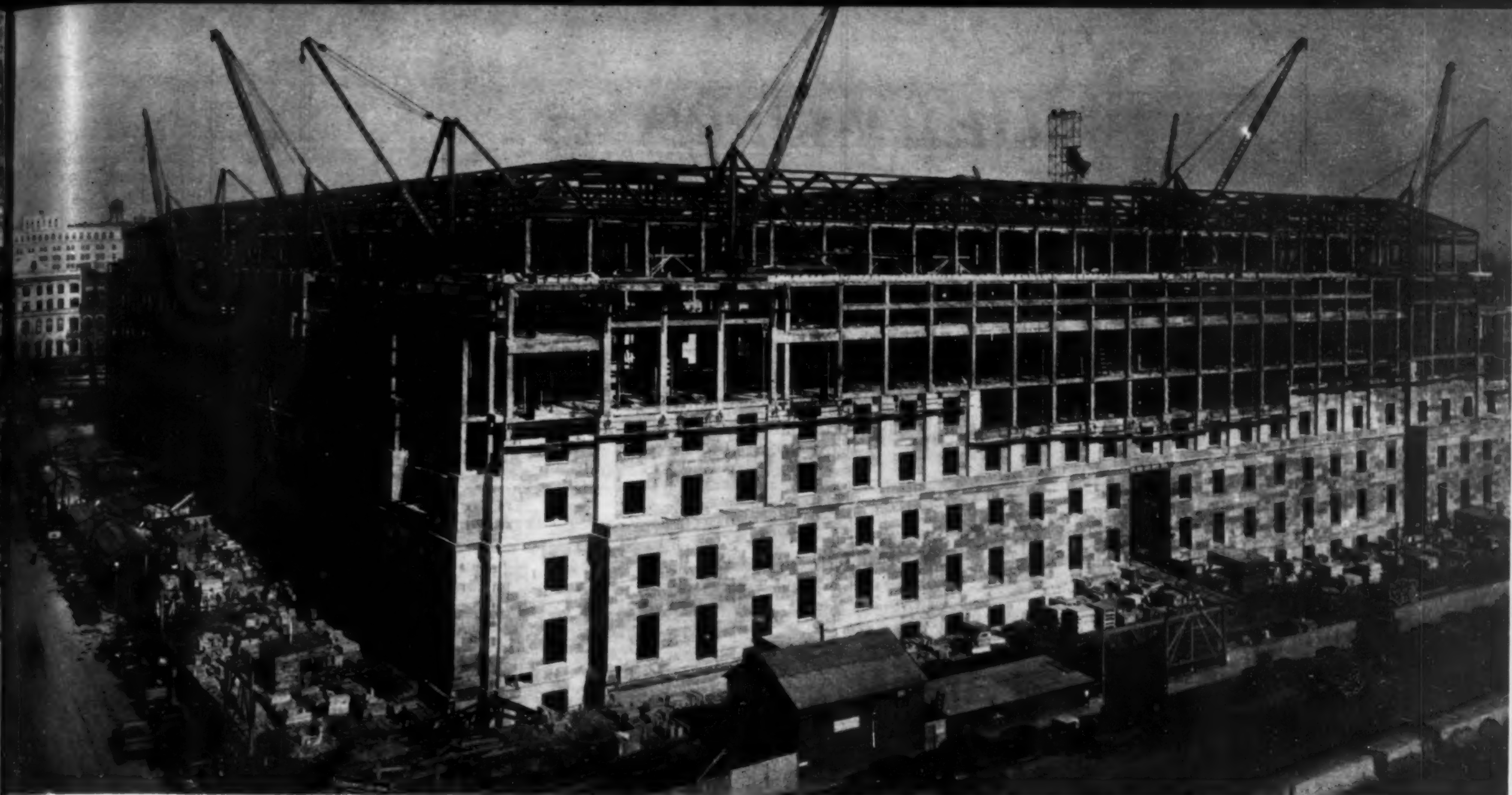
CRAFTSMANSHIP REWARDED as 69-story R.C.A. building in Rockefeller Center, New York, is completed. John D. Rockefeller, 3rd, congratulates Fred Pfeiffer, stone carver, on receiving certificate of merit from John R. Kilpatrick, representing New York Building Congress.



Acme

OPEN-MESH STEEL FLOOR reduces dead weight on bascule span of University bridge, Seattle, Wash. City's Department of Public Works builds roadway of Irving Iron Works grating weighing, with supporting 6-in. channels on 15-in. centers, 21.2 lb. per square foot.

MULTIPLE ARCH SECTIONS *(right)* of concrete form major part of Texas Hydro-electric Co.'s Hamilton dam on Colorado River. Non-overflow length is 1,960 ft., consisting of 28 bays of 70-ft. span, with maximum height of 154 ft. Contractor, Fegles Construction Co.

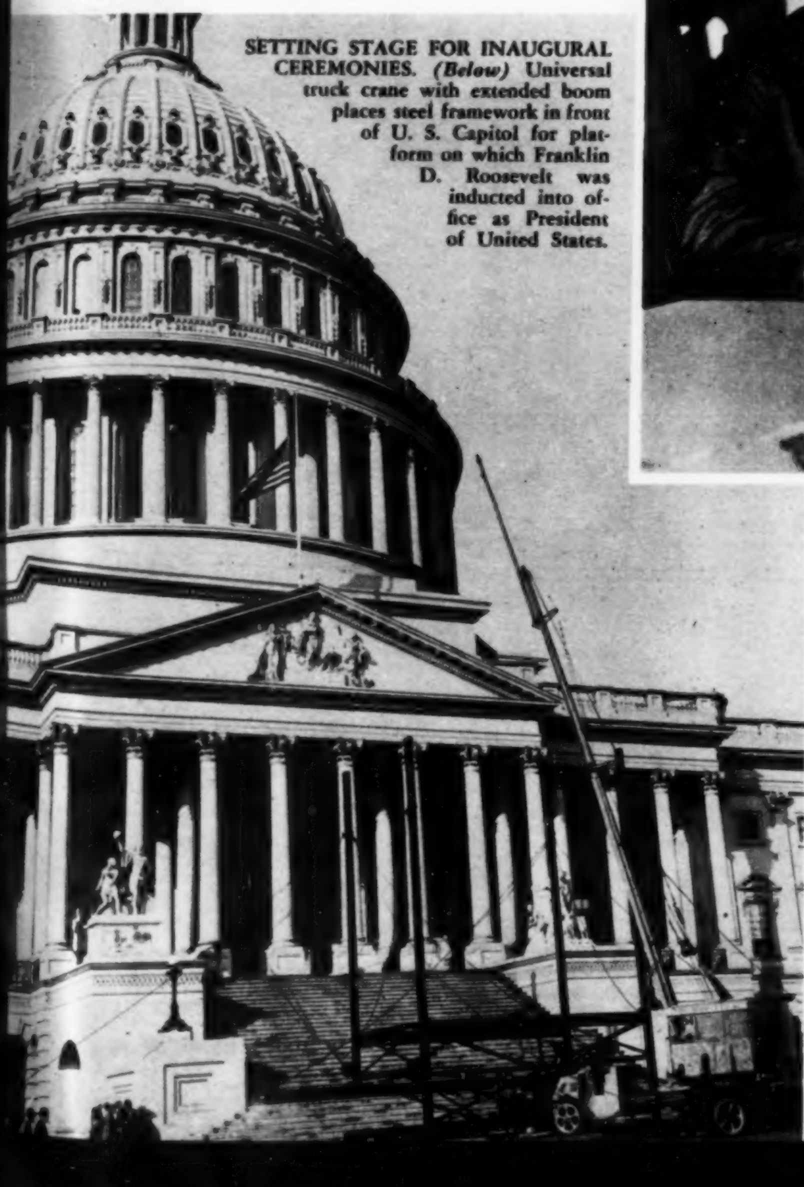


TO HOUSE DEPARTMENT OF JUSTICE at Washington, D. C., George A. Fuller Co., under direction of Office of Supervising Architect, U. S. Treasury Department, is completing monumental structure forming part of Federal Government's building group. Architects, Zantzinger, Borie & Medary.

SEEK R.F.C. CONSTRUCTION LOAN *(right)* to relieve unemployment in New York. Former Governor Alfred E. Smith and U. S. Senator Robert F. Wagner present case for self-liquidating projects to Chairman Atlee Pomerene of Reconstruction Finance Corporation in Washington, D. C.

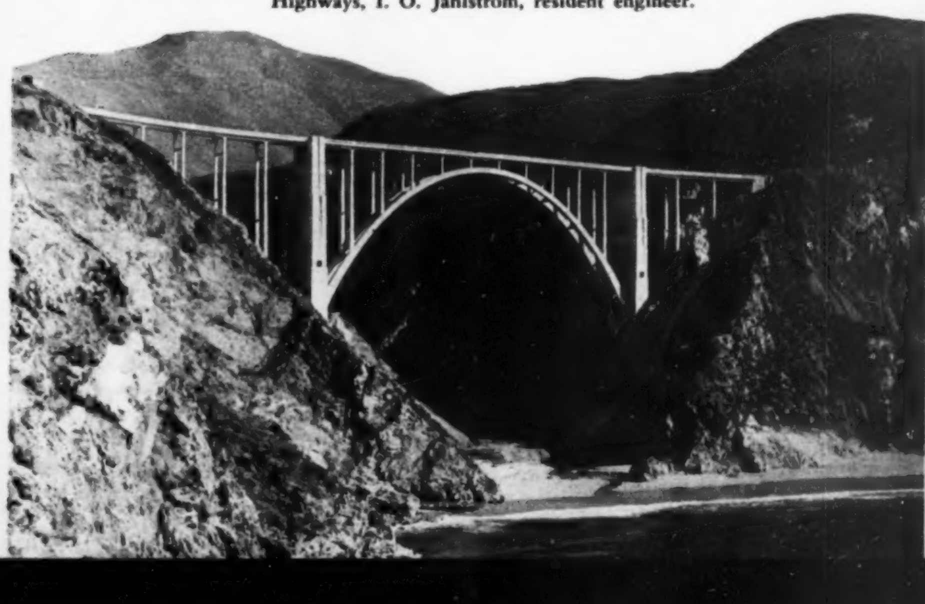
Wide World

Wide World



SETTING STAGE FOR INAUGURAL CEREMONIES. *(Below)* Universal truck crane with extended boom places steel framework in front of U. S. Capitol for platform on which Franklin D. Roosevelt was inducted into office as President of United States.

NEW CONCRETE ARCH *(below)* spans Bixby Creek on route of San Francisco-Los Angeles main highway in California. Structure with span of 342 ft. and height of 260 ft. was built with aid of timber falsework by Ward Engineering Co. of San Francisco for California Division of Highways, I. O. Jahlstrom, resident engineer.



JULIAN L. SCHLEY, Governor of the Canal Zone and lieutenant-colonel, Corps of Engineers, U. S. Army, under whose administration the Madden dam is being built from designs prepared by the U. S. Bureau of Reclamation.

Heavy-Duty Construction Plant for MADDEN DAM *Designed for High Salvage Value*

FAMILY QUARTERS for contractor's personnel. Houses in jungle clearing are elevated on posts set in cups of asphalt to bar tropical insects and reptiles.

CONSTRUCTION plant designed to mix and place 500,000 cu.yd. of concrete is in operation at the Madden dam, being built across the Chagres River at an estimated cost of $4,050,000 to regulate floods and augment water supply for lockages at the Panama Canal. Although only about 10 mi. distant from the canal, the site of the dam is in a tropical jungle, a condition that created special problems of designing and transporting heavy equipment and structural members and delivering materials to the job.

The dam has a main section 900 ft. long and 220 ft. in maximum height, flanked by a concrete-paved

EARLY CONSTRUCTION STAGE at Madden dam, showing levee construction for main dam area in August, 1932. To provide seepage cutoff 60-ft. steel sheet piling is driven to rock. Cableway tower is on trestle in background.

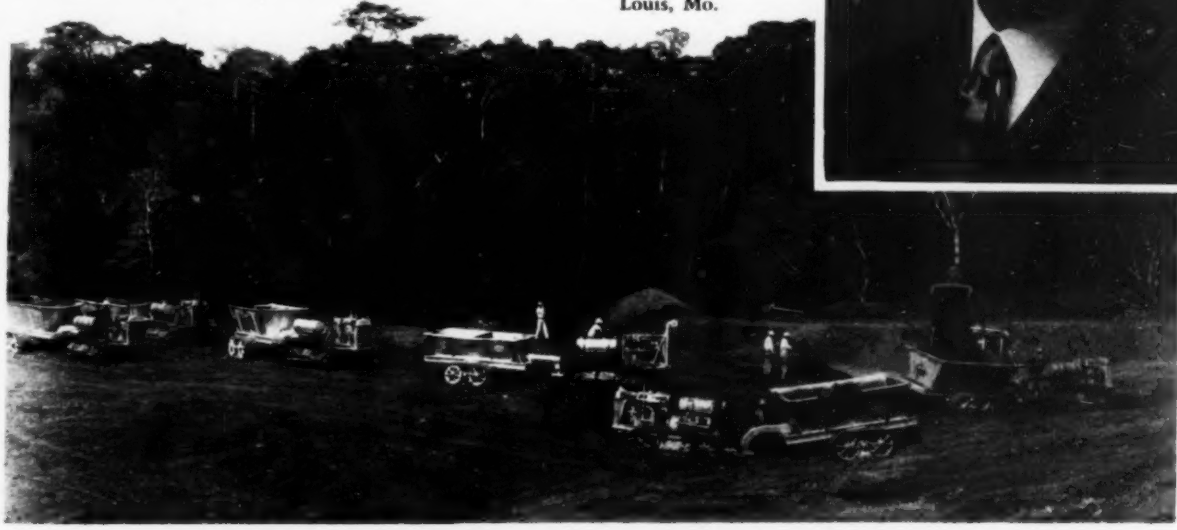
earth and rock embankment and supplemented by a number of earth-fill "saddle" dams of various sizes to form a reservoir with a normal capacity of 506,000 acre-ft.

The major elements of the plant layout developed by the W. E. Callahan Constructon Co., of St. Louis, Mo., and Peterson, Shirley & Gunther, of Omaha, Neb., contractors, include (1) a gravel screening plant served by a mile-long aerial tramway (described in CONSTRUCTION METHODS last month); (2) a cement-handling and bulking plant; (3) a concrete mixing plant, equipped with three 2-yd. units having a combined capacity of 120 cu.yd. per hour; and (4) a 25-ton cableway with a span of 1,325 ft. across the damsite.

Design for Salvage Value—Practically all of the plant for the Madden dam is new, and while designed to meet the special conditions of that job, particular consideration was given to obtaining a high salvage value by making each unit readily adaptable to other projects. All important and salvageable structures were built of structural steel, partly because of the favorable steel market and because of the rapid decay of wood due to climatic conditions, but mainly to create a plant of maximum dependability and one low in maintenance expense and fire hazard. Shop-riveted members were designed for compact shipping and easy assembly and dismantling. Field joints were generally bolted, in some cases a special, patented "rivet-bolt" being used which is capable of developing the same strength in a joint as is obtained with hot driven rivets.

Aerial Tramway and Screening Plant—Taking up the various units of the plant in the sequence of material movements, the first important section comprises an aerial tramway one mile in length capable of delivering 225 tons of gravel per hour to the screening plant, as described in last month's issue of CONSTRUCTION

W. E. CALLAHAN, president of W. E. Callahan Construction Co., of St. Louis, Mo.



AT BORROW PIT power shovel loads earth into tractor-hauled crawler-mounted wagons for transport to auxiliary saddle dams and Left Ridge earth embankment.

CABLEWAY of 1,325-ft. span and 25 tons capacity is supported by traveling towers 100 ft. high. Concrete for blocks of main dam structure within cofferdam is delivered in 8-yd. cableway buckets and rock excavation for foundation was removed in 10-yd. skips. Concrete portion of dam is 900 ft. long with 436-ft. spillway section. Maximum height is 220 ft.

EDWARD PETERSON, of the contracting firm of Peterson, Shirley & Gunther, Omaha, Neb.

METHODS. About 600,000 cu.yd. of gravel will be transported over this tramway.

The terminal of the aerial tramway is mounted directly on top of the screening plant to provide a gravity flow. The screening plant is required to produce five different products: sand, pea gravel ¼ to ¾ in., two sizes of gravel ¾ to 1½ in. and 1½ to 3 in., and cobbles 3 to 6 in. in size. Gravel is drawn from the tramway hopper by a cast-steel plate feeder to a Link-Belt rotary screen which separates the material into three sizes: smaller than 1½ in., from 1½ to 3 in., and cobbles from 3 to 6 in. The last two sizes drop through chutes directly to the storage pile.

The material from the first section of screen is fed to two Link-Belt

CABLEWAY CARRIAGE delivers concrete to dam in special 8-yd. bucket, designed by A. J. Ackerman, chief engineer for contractors. Bucket has 4.5 sq.ft. of discharge area for rapid emptying where large aggregates are used in mix. Bottom gate is manually controlled for any desired size of opening.

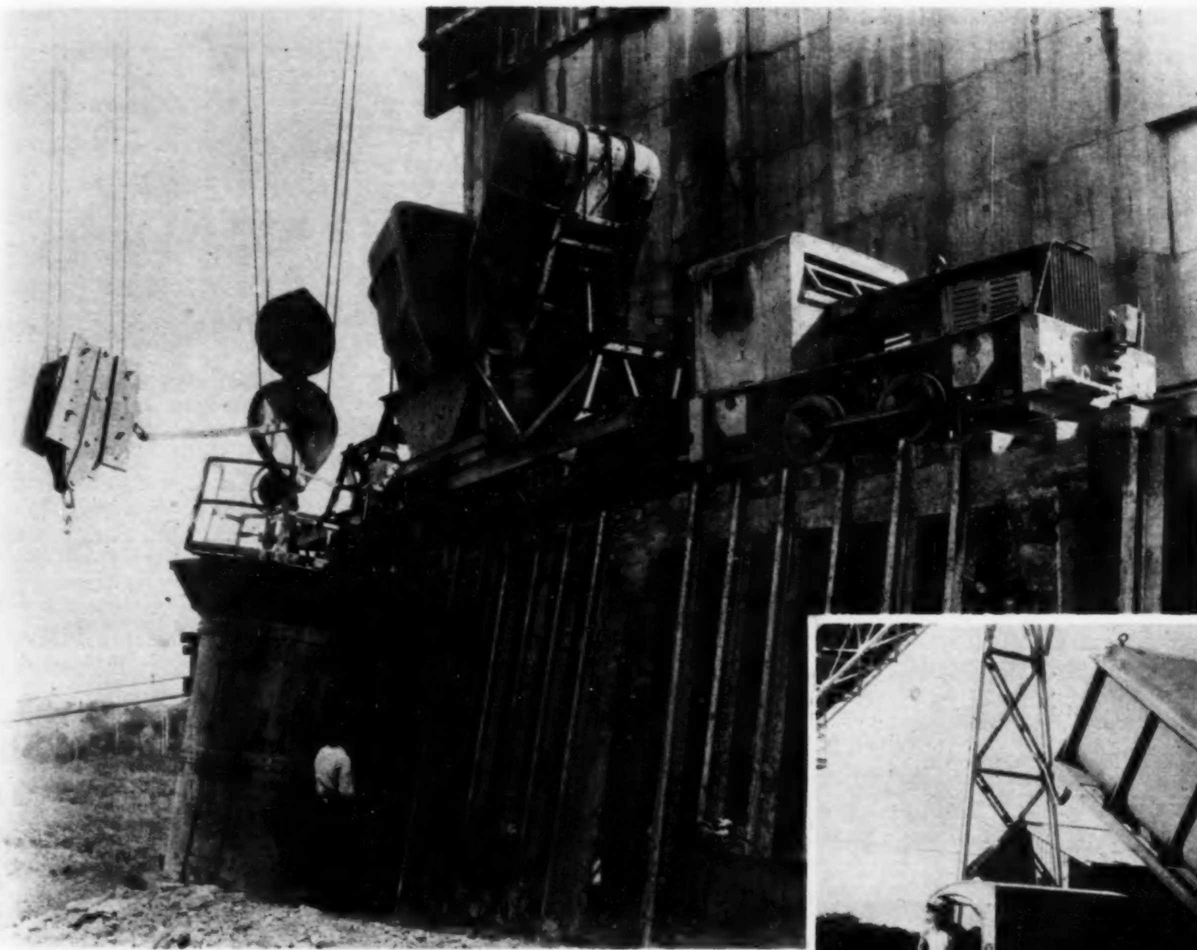
WHEEL MOUNTING DETAILS *(below)* of 100-ft. traveling cableway tower. Vertical wheels are fully equalized and horizontal wheels take lateral pull of cable. This design eliminates wheel breakage.

TRAVELING TOWER of structural steel is 100 ft. high and operates on 40-ft. high steel trestle. Span, 1,325 ft.; capacity, 25 tons. Each of two towers weighs 340 tons and is equipped with 32 wheels. Track consists of four rails laid in pairs, 8-ft. gage.

double-deck vibrating screens. The upper vibrating screen passes everything below ¾ in. to produce the ¾- to 1½-in. size, which drops vertically to the storage pile. The lower screen of ¼-in. mesh separates the sand and discharges the ¼ to ¾ in. size directly to the storage pile. The sand is dropped to a Dorr rotary washer which also discharges its product downward to a storage pile. In addition to the direct washing of the sand, water is sprayed through a 6-in. pipe on the axis of the rotary screen to wash the larger sizes, and high pressure nozzles set over the vibrating screens wash the small sizes.

Conveyor—A reinforced concrete tunnel extends under the full length of the gravel storage pile with chutes and gates feeding laterally from the under side of these piles to a 260-ft. Link-Belt conveyor delivering to the mixing plant. Its capacity is 250

HERMAN GUNTHER, of Peterson, Shirley & Gunther, contractors, Omaha, Neb.



CONCRETE DELIVERY TRAIN, with dual-hopper car, transfers 8 cu.yd. of concrete from mixing plant to cableway bucket. Standing alongside bucket is signal man with direct telephone connection to operator in cableway head-tower.

CEMENT TRUCK has capacity of 60 barrels and is equipped with cover which may be removed for hauling other materials.

tons per hour and it operates at an angle of 15.5 deg.

Mixing Plant—Special consideration was given to the design of the mixing plant to make it readily adaptable to other jobs or for use as a ready-mix plant. The storage bins were designed to contain six different materials on a basis of 1:2:4 proportion of concrete in sufficient quantity to provide a day's run at full capacity. The watertight cement bin is located in the center portion of the structure and two sand bins and four gravel bins surround the cement. The structural units were shop-riveted, but all field connections were bolted, using Dardalet rivet-bolts with self-locking nuts.

Cement is delivered to the plant by a Fuller-Kinyon conveyor system from a 6,000-bbl. steel silo located adjacent to the plant.

The plant has a capacity of 120 cu.yd. per hour on the basis of a 3-min. cycle for a 2-yd. batch. All materials are carefully weighed through individual Johnson batchers and separate scales. The filling of the sand and smaller size gravel batchers is done manually, but the gate above the cobble batcher is mounted on rollers and operated by air pressure. The cement batcher is filled automatically after being started by an electric push button and has a major stream flow, with a final dribble stream which cuts off automatically at the specified weight with very little error.

The dumping of the batchers is accomplished from a panel board by electric solenoids which trip the batcher gates, these gates reclosing automatically through the action of counterweights. The discharge gate on the cement batcher operates by air pressure for positive control of sealing.

The batchers dump into a single hopper, on the under side of which is mounted a rotating spout which may be turned to deliver the aggregates into any one of three 2-yd. Smith mixers mounted radially with their discharge spouts pointed toward the center of the plant for dumping into a single spout to the concrete train below.

Transportation of Concrete—Concrete is hauled to the dam within reach of the cableway by two units, each consisting of an 8-ton Vulcan gasoline locomotive and a special Koppel car on which are mounted two 4-yd. hoppers. At the point of dumping into the 8-yd. cableway bucket an electric circuit is plugged into the car, and a motor-driven oil pump develops pressure in two hoisting cylinders, causing the two hoppers to be tipped toward each other, discharging the concrete through a common spout into the bucket. Instead of providing a special loading point for the bucket, a trestle was constructed along the full range of the cableway so that the concrete bucket might be landed at any point. This system has proved very satisfactory and a great time saver for the cableway.

Cableway—The choice of a cableway for serving the Madden dam area was based partly on the suitability of the topography and also because the speed of construction was limited by the Government specifications allowing not more than 30 ft. of concrete to be placed in any block in the dam structure during a month's period. Since all equipment and materials for the dam are hauled a distance of 13 mi. by truck, a capacity of 25 tons was considered ample to handle the heaviest pieces, and for normal operations the cableway will be required to handle an 8-yd. load of concrete with bucket weighing about 20 tons, as illustrated in an accompanying photograph, or rock skips with a capacity of 10 cu.yd.

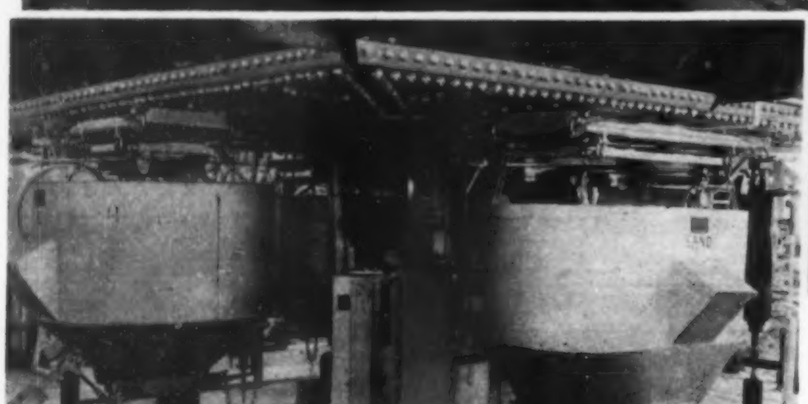
One of the most noteworthy features of the towers is the introduction of horizontal wheels at the rear to take the entire cable reactions. Thirty-two wheels take the vertical load of each tower, with full equalizing of load within each group of wheels. The best crane practice was employed in the design of the trucks and wheels, which were manufactured by the Whiting Corp. While it has been a common occurrence, heretofore, to break quite a number of wheels during the period of a job, no breakage occurred during the first six months of operation, and it is

CONSTRUCTION PERSONNEL at Madden dam. *(Left to right)* A. J. ACKERMAN, chief engineer, and PAUL GRAFE, vice-president, for Callahan organization; E. S. RANDOLPH, construction engineer for U. S. Government, Panama Canal.

J. P. SHIRLEY (*left*), of Peterson, Shirley & Gunther, contractors, of Omaha, Neb.

PAPER CEMENT BAGS (*right*), slit open when they drop upon sharp steel knives of cutter, are tumbled in revolving screen to remove contents for feeding into bulk silo.

CONCRETE PLANT, showing screening plant and aerial tramway discharge terminal (at extreme left), belt conveyors to mixing plant (at right), and silo for bulk cement (in foreground). Gravel storage and conveyors are covered to protect materials during tropical rainy season.



WEIGHING BATCHERS under aggregate bins at concrete mixing plant dump into single hopper with rotating spout serving any one of three 2-yd. mixers.

very unlikely that with the present arrangement such failure can occur.

During the early stages of the design of the towers announcement was made of the newly developed Dardalet rivet-bolt, a patented bolt with a self-locking thread and fluted shanks, the outside diameter being larger than the hole, so that on driving the bolts with a heavy hammer the shanks deform and produce a tight fit to improve the shearing resistance of the bolt. These bolts were adopted for the cableway towers. The erection with this type of bolt was greatly simplified and the dismantling will be considerably easier and leave the structural members in better condition for re-use elsewhere than by burning off and backing out hot driven rivets.

Each tower is 100 ft. high and travels on two pairs of rails 60 ft. between centers of each pair, and 8 ft. between centers of rail. Traversing of the towers at 66 ft. per minute is accomplished with the usual Lidgerwood system, consisting of a 100-hp. endless drum mounted on the tower and three parts of cable extending on each side to the ends of the runway where the dead ends are looped over sheaves to counterweights. The track cable, manufactured by the American Steel & Wire Co., is 3 in. in diameter, of lock coil type. The present installation represents the first use of this large diameter cable.

The cableway span is 1,325 ft. and when carrying a maximum load of 35 tons, dead plus live, under a deflection of 5 per cent, will be stressed up to 425,000 lb. The mechanical equipment on the cableway is of latest Lidgerwood design, with General Electric remote control equipment. The carriage is in two parts and contains twelve track wheels spaced 33 in. on centers, providing a wide distribution of load on the cable. The hoist consists of a two-drum unit with an auxiliary drum for handling rock skips and is driven by a 400-hp. General Electric motor of the induction type. The carriage travels at a speed of 1,200 ft. per minute between the two towers, and the load travels vertically at a rate of 300 ft. per minute.

For excavating, 10-yd. Koppel rock skips, designed for cableway dumping, are provided. The concrete bucket was designed by A. J. Ackerman, chief engineer for the contractors, and built in the Balboa shops of the Panama Canal.

Cement Handling — Cement requirements for the Madden dam are

SADDLE DAM CONSTRUCTION, showing concrete corewall and earth fill compacted by tractor-drawn sheep's-foot roller.

R. M. CONNER, general superintendent for the contractors on the Madden dam.

WOOD FORMS under construction for reinforced concrete corewall of one of the earth saddle dams.

WILLIAM McCORMICK, secretary-treasurer of W. E. Callahan Construction Co., St. Louis, Mo.

about 700,000 bbl. The design of a plant for economically handling such a large quantity was complicated by the necessity of receiving ocean shipments in large increments and storing the cement with adequate protection against very damp climatic conditions.

All cement is furnished by the U. S. Government. From earlier experiences the Panama Canal found paper bags most satisfactory as a protection against moisture accumulation in transit, as well as in tropical storage. The specifications for the bags call for six plies, with the one next to the inner one paraffin-coated and all seams glued with a special moisture-resisting compound except over the filler valve.

The cement storage facilities of the contractors consists of two steel silos, each having a capacity of 6,650 bbl. of bulk cement. This is comparatively small, but demurrage on cars has been taken into account and will be permitted to occur to an amount equivalent to the non-salvageable cost of additional storage capacity.

Bulking Plant—At Madden siding cars are spotted under a shed alongside a belt conveyor from the end of which the paper bags drop through a chute upon sharp steel knives of a bag cutter. At the lower end of the chute the slit bags drop into a rotary screen, where the cement is effectively removed, dropping into a hopper while the slit paper bags are discharged at the end of the screen.

The cement is fed into a Fuller-Kinyon system and conveyed by air 70 ft. vertically into a steel silo built up of ¼-in. steel plate and bolted for easy salvage. It has a diameter of 30 ft. and is elevated on columns to permit loading of trucks from the under side. The bottom cone was assembled with flat head bolts in countersunk holes to reduce the tendency for arching of the cement. In addition, air jets are installed over the entire lower portion of the cone with separate valves for each pair of jets for breaking up arches. Every precaution was taken to prevent moisture from entering or forming in the interior of the silo. All joints and bolt holes were painted with asphalt and the entire silo was painted with aluminum paint because its reflective power of the sun's rays is known to reduce condensation or "sweating" on the inside.

From Madden siding to the concrete plant at Madden dam the cement is hauled by trucks a distance of 13 mi. and delivered to a second steel silo alongside the concrete mixing plant.

Personnel — The Madden dam project was designed by the Bureau of Reclamation for the Panama Canal and is being constructed by the W. E. Callahan Construction Co. and Peterson, Shirley & Gunther, under the supervision of the Canal Zone administration, including Julian L. Schley, Governor; Col. C. S. Ridley, engineer of maintenance; and Major J. C. Mehaffey, assistant engineer of maintenance. E. S. Randolph, construction engineer, is in direct charge of the work; I. E. Burks is chief concrete technician, and A. W. Brooks, engineer on the dam.

For the contractors, Paul Grafe is managing director and R. M. Conner is general superintendent. The general features of the construction plant were defined by M. H. Slocum and L. D. Crawford. The structural and mechanical design, as well as the fabrication and erection, were carried out under the supervision of A. J. Ackerman, chief engineer, who supplied the information on which this article is based. Structural steel was fabricated by Stupp Bros. Bridge & Iron Co. and the Virginia Bridge and Iron Co.

BEFORE ALTERATIONS on Fourth St. apartment building in Philadelphia.

Philadelphia Campaign to "RENOVIZE" Yields Jobs on Pledged Work Valued at $21,000,000

AFTER ALTERATIONS undertaken as result of Renovize Philadelphia campaign.

RESIDENTS of Philadelphia will spend more than $21,000,000 in property remodeling within the next six months as a result of the Renovize Philadelphia Campaign, conducted under the leadership of local business and professional men and women and labor leaders in order to induce citizens to make needed building repairs and improvements as a means of relieving unemployment. In a paper presented before the Highway and Building Congress in Detroit in January, the source of the following notes, A. E. Horst, secretary-treasurer of the Henry W. Horst Co., general contractor, and chairman of the Philadelphia campaign's Construction Committee, told how the mass movement was organized.

Early in 1932, when the Renovize campaign was conceived by the Philadelphia Federation of the Construction Industry, it was thought that the ultimate outcome would be at best a modest relief of building craftsmen from the horrors of idleness and a reassuring activity for reliable contractors, subcontractors and material firms in Philadelphia's building industry. It was originally hoped that $15,000,000 of additional purchasing power could be injected into Philadelphia business through the channels of the construction industry. Today, as a result of active solicitation the original goal has been passed, with pledges of $21,000,000 worth of work.

The idea of the Renovize Philadelphia Campaign was incubating for five or six months while the leaders behind the movement were seeking to enlist the interest and support of a representative business and civic leader to serve as general chairman of the campaign committee. This leader was found in William A. Law, president of the Penn Mutual Life Insurance Co. who jointly with his responsibilities as chairman of the Renovize campaign is also the third Federal Reserve district chairman of the Committee on Home and Mortgage Financing.

Policies Economically Sound—Certain definite economic policies were kept in mind in developing this campaign. While the prices of materials are fixed by the inexorable law of supply and demand, frequently the price of labor is not. To be certain that labor in Philadelphia's construction industry would cooperate in the Renovize Campaign by performing work at wage rates consistent with the rates prevailing in other lines of industry, the cooperation of the labor leaders was sought and obtained. The labor groups have expressed their willingness to cooperate by doing the work developed by the campaign at wage rates that ignore any normal group restrictions. In brief, the Renovize work done by the craftsmen in the various divisions in the construction industry, both union and non-union artisans, is being done at rates that recognize the crying need for employment.

POSTERS AND WINDOW DISPLAYS, such as the one above by Bonwit Teller & Co., women's apparel shop, stimulated interest in the Renovize campaign.

In order that the work turned up by the Renovize campaign might be utilized directly to relieve unemployment in neighborhood centers, the property owner, through a personal approach, has been encouraged to have the work done through the contracting firms or craftsmen in his neighborhood. In fact, one of the guiding principles of the campaign has been to have the work done through the regular channels of the construction industry, without favoring any particular trade group or individual contracting firm. Each private business firm or craftsman in the industry qualified to do reputable work has thus been given equal opportunity of meeting his own unemployment problem by exercising his own business initiative and foresight.

Inferentially, the whole tenor of this Renovize Philadelphia Campaign is something quite distinct from the "made work" movement. It was definitely decided at the outset not to try to control the army of unemployed craftsmen in the building industry by attempting to allot to them specific jobs developed by the campaign. It was clearly recognized that the unemployment problem applies as much to the contracting or jobbing firm as to the individual unemployed craftsman, and hence care has been taken to help both types of unemployment in the construction industry, deliberately seeking to avoid the establishment of machinery which would break down the regular method of doing business.

Mass Selling—The metropolitan district of Philadelphia including the main suburban areas, was subdivided into 22 geographic divisions in which 7,000 volunteer solicitors coming from the membership of interested civic, business, community, trade and religious organizations, under the guidance of competent colonels and captains, properly trained by the Philadelphia Association of Sales Managers, undertook

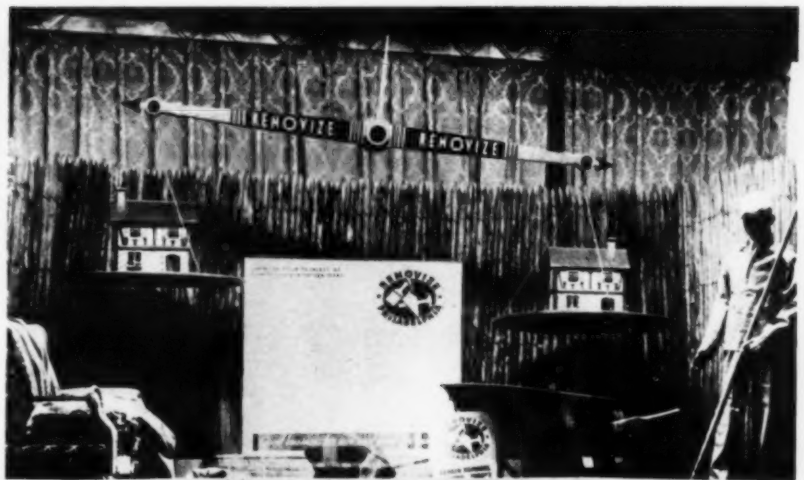
a house-to-house, business-property to business-property canvass. The home owner or mortgagee is asked to indicate on a signed pledge card the amount of money which he reasonably believes he can see his way clear to spend in repairing and modernizing his home or business property. To be certain that the property owners have fulfilled their original pledges a comprehensive follow-up procedure will extend over a six-months' period.

The administration features of the campaign have been handled by nine separate operating committees under the general chairmanship of Horace P. Liversidge, who is also chairman of the executive committee of the Philadelphia Federation of the Construction Industry, which in turn has its policies determined by a general council under the chairmanship of William A. Law. The general council consists of forty business and professional leaders of Philadelphia.

With the generous cooperation of Philadelphia architects and engineers, a competent staff was organized to furnish preliminary counsel to property owners on any architectural or engineering problem that might occur in connection with the renovation of their properties. The Architectural and Engineering Bureau, however, will not furnish working drawings or specifications and hence will not trespass or interfere with the regular services of architects and engineers.

There has been established a Construction Bureau composed of the leading reputable contractors and subcontractors, the function of which is to give advice to property owners on estimates and the award of contracts thereunder. Whenever, therefore, any property owner is in doubt concerning any phase of the mechanical work which he is planning to do, he will be able to turn to this Construction Bureau for competent though preliminary suggestions.

Seven different sets of check lists of suggestions have been prepared to give to the owners of homes and various types of business buildings an exhaustive list of items to be scanned on their individual properties—the first time in building history that such lists have been prepared for and used by the public.



A. E. HORST, Philadelphia contractor and past-president of the Associated General Contractors, is chairman of the Construction Committee of the Renovize Philadelphia Campaign.

DEPARTMENT STORES aided the movement by featuring opportunities to Renovize in window displays like the one by Gimbel Bros. *(above)*.

The campaign could not have attained success without a comprehensive and carefully planned publicity program. This entire publicity program, performed by N. W. Ayer & Son, Inc., has been conducted without cost, except for the absolutely unavoidable expenses involved in printing and artist work. Newspaper space, space on the Pennsylvania and Reading Railroad suburban lines, space in Philadelphia Rapid Transit Company's trolleys, buses, subways and elevated trains, window displays by every prominent department store, full billboard coverage, plugs and spots in radio announcements aggregating several hundred, even advertising by the autogiro—all have been given willingly and gratuitously.

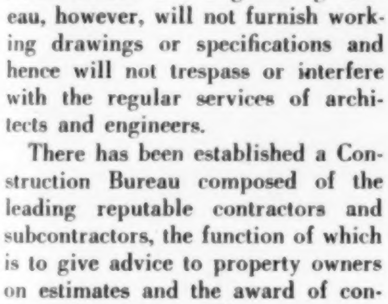
Renovize Exposition—To visualize the methods by which modern materials and methods of construction can be used to renovize the home, a renovize exposition, covering 6,000 sq.ft. of floor space in one of the centrally located office buildings of Philadelphia has been inaugurated as an integral part of the campaign. Open free to the public every day from 9:00 a.m. to 5:30 p.m., it is expected that this exposition will attract thousands of home owners who, observing the practical means by which they can "renovize," will be induced to repair, restore and renew their homes at today's bargain prices. The exposition is a "before and after" exhibit, showing how modernization can be effected from cellar to attic. In addition, there is a motion picture demonstration of various ways to make the home more attractive.

With more than $21,000,000 already pledged, and the campaign being continued with the hope of rolling the total up to $25,000,000, there can hardly be any question of the dynamic character of this campaign to relieve unemployment, stimulate business activity and restore business confidence.

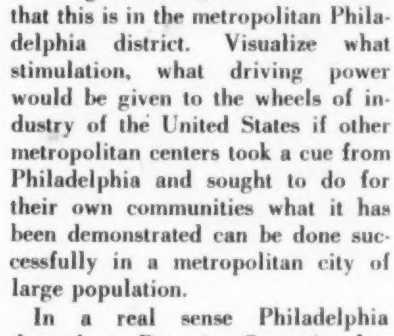
Today there is no doubt that many business leaders fail to appreciate that the stage is set, as never before in the history of this nation, to take the step and do the thing which will not only overcome the inertia under which business has been struggling vainly, forlornly and without heart, but also will inspire confidence in the future, without which no real revival of business can proceed. Certainly the physical factors of labor and material are in such a state that they afford full opportunity for alert and far-sighted business men to make commitments now with reasonable assurance that they will be justified by future prices and wage levels.

With the picture thus set, every dollar added to the regular channels of trade means a gross annual volume of business of $25, for authoritative studies of the Federal Reserve system clearly show that every dollar put into circulation multiplies 25 times in the period of a year. This means that if the Renovize Philadelphia Campaign brings back into the channels of trade 25,000,000 additional dollars, it will give rise to a gross annual amount of business totalling $625,000,000. Mark well that this is in the metropolitan Philadelphia district. Visualize what stimulation, what driving power would be given to the wheels of industry of the United States if other metropolitan centers took a cue from Philadelphia and sought to do for their own communities what it has been demonstrated can be done successfully in a metropolitan city of large population.

In a real sense Philadelphia through its Renovize Campaign has pointed the way to the nation. It has shown that with a business-like organization even the scattered and diversified interests of a metropolitan area can be made coherent and articulate, and that it can be induced to act with an irresistible solidarity to attain a common goal. The closely-knit spirit prevailing in smaller cities and towns is not a fundamental prerequisite to the success of a Renovize campaign. With courage, foresight, and dynamic action this magnificent movement can be carried into every metropolitan center of United States.

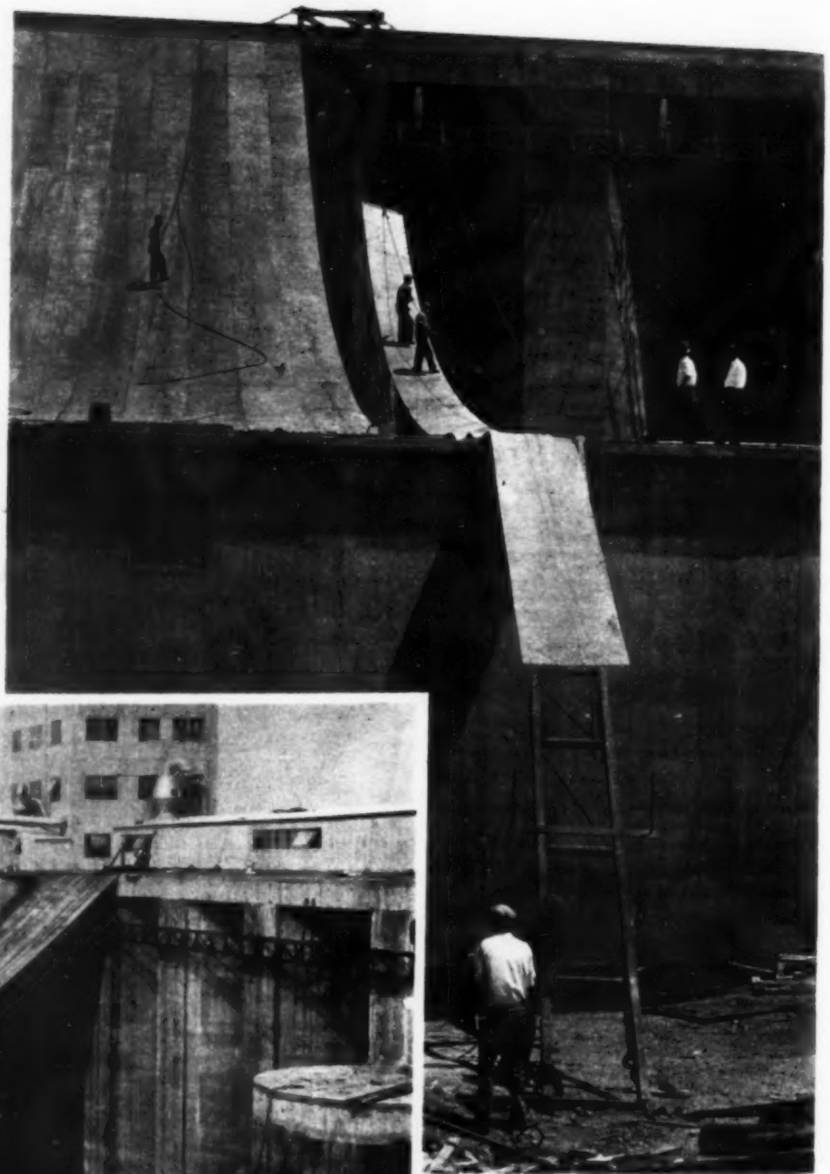


ORIGINAL FACADE of old run-down apartment building.

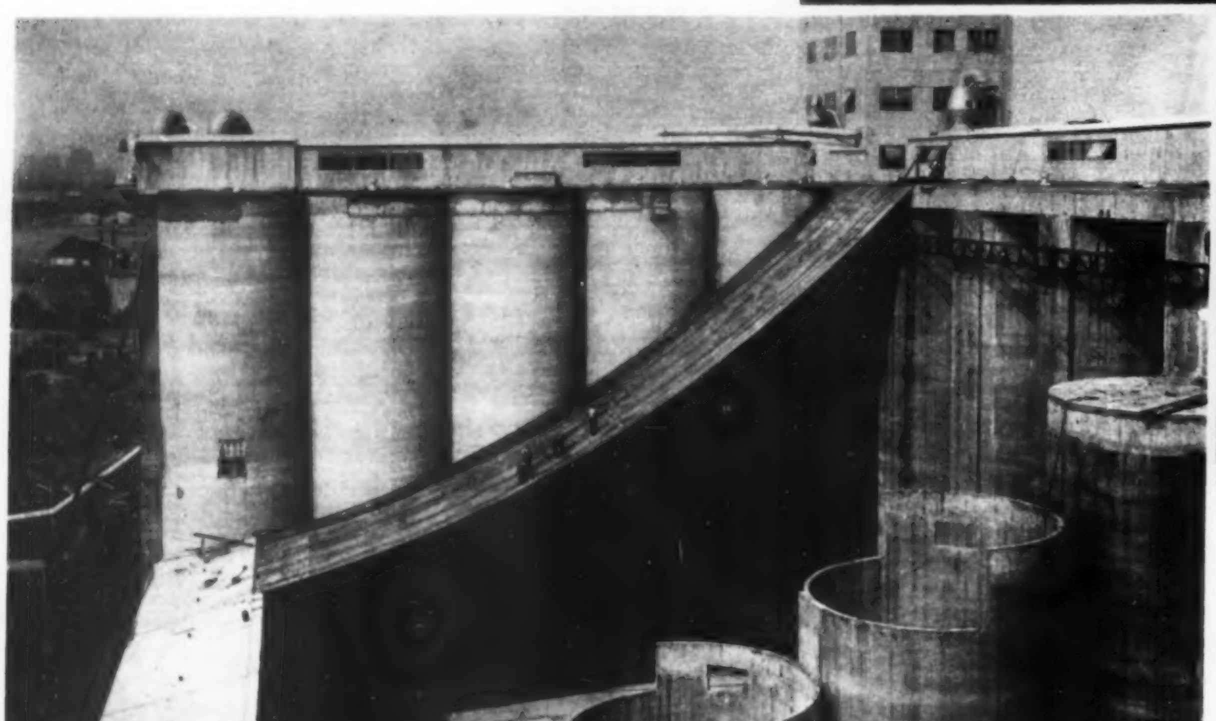


AFTER RENOVIZING, appearance of building is modernized.

Grain Bins Covered by "AWNING" ROOF *of Self-Supporting Welded Steel Plates*



STRIP OF WELDED 12-GAGE STEEL PLATE, 50 in. wide and 140 ft. long, is drawn by hauling line from ground to permanent position in suspended roof.



SUSPENDED, SELF-SUPPORTING STEEL-PLATE ROOF made up of welded strips hangs in natural curve between upper and lower bolted anchorages.

R. L. HOLT (left), construction engineer, Albany Port District Commission; DWIGHT B. LA DU, commissioner; PETER G. TEN EYCK, chairman of commission, and WILLIAM J. FLYNN, vice-chairman.

CONSTRUCTION of four suspended, self-supporting, welded steel-plate roofs covering large storage bins of a 13,000,000-bu. grain elevator of the Port of Albany, on the Hudson River at Albany, N. Y., called for an erection scheme as original as the design of the roofs themselves. The Albany project, representing the largest single-unit grain elevator in the world, was designed and built by the James Stewart Corp., of Chicago. Before awarding a subcontract for the erection and welding of the four suspended roofs, each of which has a steel surface area 288 ft. 10 in. in length by 139 ft. on the slope, the general contractor and the Albany Port District Commission, owner of the elevator, made a thorough study of the erection plans proposed by various bidders. On the basis of its scheme, the work was assigned to the J. K. Welding Co., Inc., of New York City.

Port District—Created by act of the state legislature, the Albany Port District includes the municipalities of Albany and Rensselaer, which occupy opposite banks of the Hudson River. Cost of terminal facilities at the port is shared by the two communities. The grain elevator is one part of a comprehensive project to provide complete facilities for transshipment of cargoes between railroads or New York State Canal barges and ocean-going ships.

Grain Elevator—Situated on the west, or Albany, side of the river just south of the city line, the grain elevator now being completed is the first of two units contemplated by the Port District Commission. Unusual construction economy is obtained by the unique design of the present unit, which provides eight steel-roofed

ALBANY GRAIN ELEVATOR provides large storage spaces under four suspended steel-plate roofs. Roof partially visible at right has been completed. Another roof will cover large area in foreground, containing partition bins which will divide storage space into two compartments.

storage bins with a capacity of 1,000,000 bu. each. The remaining 5,000,000 bu. of the 13,000,000-bu. total capacity is stored in 104 circular concrete bins of the unit.

Bin Layout—As shown by the plan published with the article describing the construction of the circular reinforced-concrete bins, in last month's issue of CONSTRUCTION METHODS, the layout of the principal rows of circular bins is roughly in the form of a double H. Bins in these rows are 97 ft. high. The large steel-roofed bins are located in the four areas inclosed on three sides by the principal rows of circular bins. Each of the four areas thus inclosed is divided into two bins by a row of four circular concrete bins which serve as a partition. These partition bins, which appear in several of the photographs, are stepped in height to conform roughly with the slope of the steel-plate roof. To complete the partitions, circular steel-plate walls are extended downward from the roof to overlap the walls of the concrete bins.

Steel Roof Design—In effect, each welded roof is a suspended steel sheet anchored at its upper edge to a concrete slab 97 ft. above the ground and at its lower edge to a slab 30 ft. above ground level. Details of the anchorages are shown in one of the drawings. Under dead load only, the curve of the roof approximates a catenary. A counterweighted structural-steel A-frame, anchored to a heavy concrete footing, as indicated by the accompanying sectional elevation, resists any overturning moment developed by the roof at its lower anchorage.

Each of the four steel roofs is made up of 72 welded 12-gage steel-plate strips, 139 ft. 8½ in. long, erected and suspended individually before being welded to the adjacent strips. The great majority of the steel strips in one roof are 50 in. wide, although additional widths of 53, 39, 38, 35, and 19 in. are used to a small extent in the design. Each strip is made up of six steel plates, four 31¼ ft. long forming the main portion of the strip, with a 10-ft. plate at one end and a 5-ft. plate at the other. Joints between the plates are butt-welded, except the joint nearest the upper end of the strip, where the upper plate overlaps 2½ in. Transverse joints in the roof are staggered by alternating the position of the 10-ft. and 5-ft. plates at the ends of adjacent strips.

Longitudinal joints between the strips in the roof are lap-welded, alternate strips being lapped 2 in. over the two adjoining strips. Six expansion joints on the roof, four on the upper half and two on the lower half, take care of transverse movement. Each of the six expansion joints is a little more than 72 ft. long. At these joints the adjacent strips are not welded together, but each joint is covered with a crimped V-shaped metal strip which is welded to the lapped plates, as indicated by the accompanying sketch.

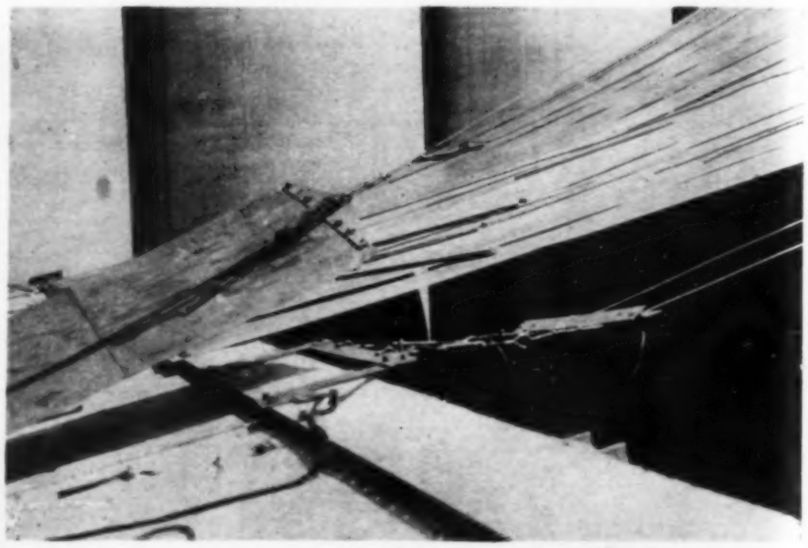
J. A. KLEVENS (left), president, and E. H. METHLIE, vice-president, J. K. Welding Co., Inc.

TACK-WELDING AT 4-IN. INTERVALS followed by final fillet welding of lapped joints fuses steel-plate strips into solid sheet. Job requires almost 55,000 lin.ft. of fillet welds.

Fabrication of Strips—The six steel plates composing a strip were welded together on a structural steel templet blocked up from the ground to form a level table. The templet, which was 140 ft. long, was made up of four sections for ease in moving. It consisted of two longitudinal 4-in. I-beams spaced about 50 in. c. to c., with cross-members at the locations of the welded joints. The templet was placed at right angles to the outer wall of the commodity bin, i.e., parallel with the direction of the strips in the roof.

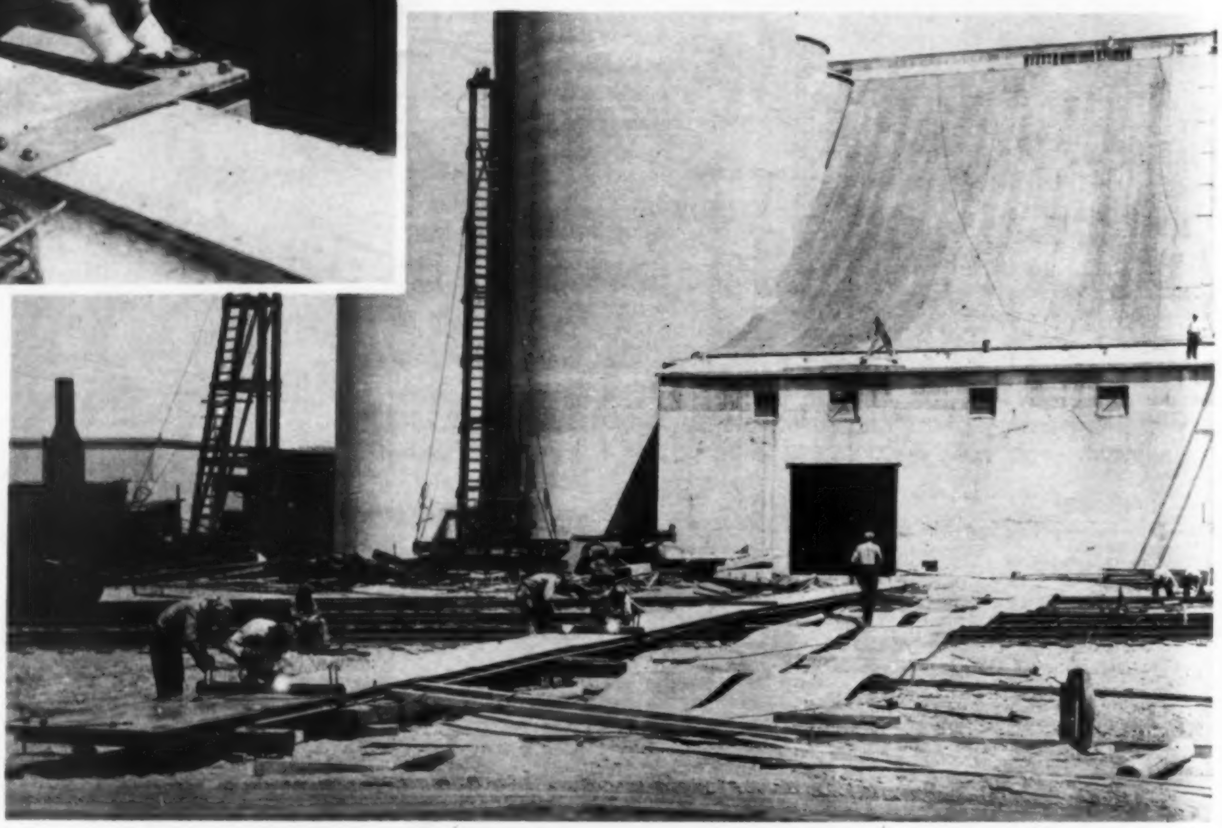
After a strip had been welded, it was pulled off the templet on to a pile alongside. In order to keep these piles approximately in line with the position which the strips were to occupy in the roof, the templet was placed at four different locations during the fabrication of strips for a 288-ft. length of bin. A 50-in. strip weighed 2,600 lb.

To handle the plates during fabrication and erection, the contractor placed a Lambert steam two-drum hoist on the ground close to the center line of the roof. In addition to the drums, the hoist was equipped with two winches which were used to operate auxiliary hemp running ropes. Trucks dragged the steel plates close to the templet, and a cable from the hoist then pulled them on to the welding table. To eliminate turning of the fabricated strip on the ground, the plates were placed on the templet in the same order which they were to occupy on the roof, with the upper end of the strip nearest the storage bin.

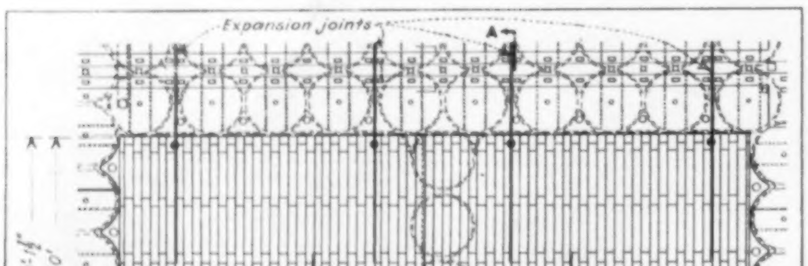


TRACK CABLES attached by bolted yokes to anchorages carry free-running skids to which advancing steel-plate strip will be fastened for support in erection.

YOKE to which track cables are attached is moved to new position for erection of next underlapping strip.



WELDERS FABRICATE SIX STEEL PLATES into 140-ft. strip by fusing four butt joints and one lap joint on structural steel templet blocked up from ground.

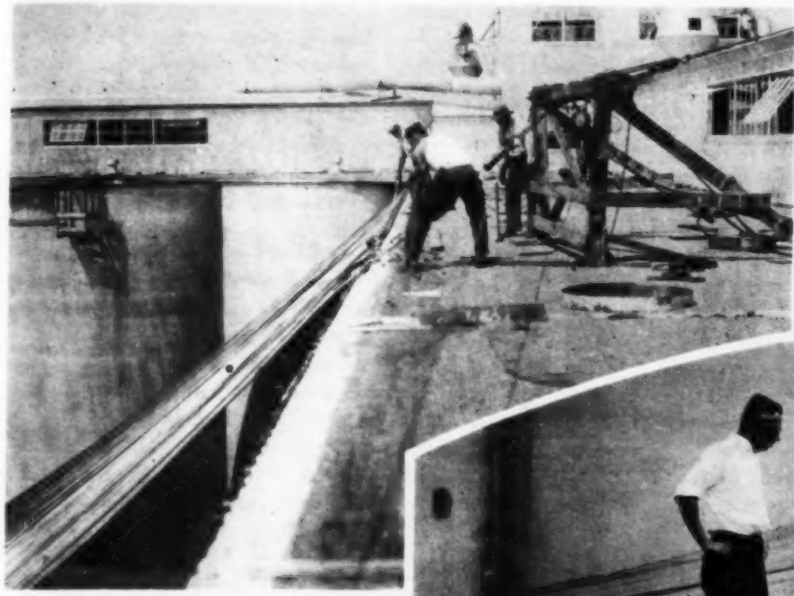


PLAN OF WELDED STEEL-PLATE ROOF. Joints of adjacent strips are staggered. Six expansion joints in roof take care of temperature changes at right angles to slope.

Two butt joints were made at a time by two welders, who started the welds at the center of the joints and worked continuously outward to the edges of the plates. As a final operation, the lap joint near the upper end of the strip was welded. The 2½-in. lap at this joint permitted the welders to adjust the final plate to obtain exactly the required length of 139 ft. 8½ in. for each strip.

Erection Procedure—Welded strips were erected individually. As alternate strips overlap the two adjoining strips, it was necessary to erect the two under strips before placing the intermediate strip in position. Suspended wire-rope track cables carried the under strips during erection. Special yokes for the two track cables were bolted to the anchorages at the upper and lower ends of the roof span.

A hauling rope from the hoist engine was reeved through an idler sheave on the upper roof in line with the hoist engine and through a second idler sheave on a movable timber deadman in line with the final position of the steel strip to be erected. Thence the rope ran to the ground, where it was fastened by a clevis to a yoke bolted to the end of the steel strip. To support the steel strip in its trip from the ground to the lower roof level, 26 ft. high, a structural steel ramp was placed from the ground to the roof, nearly in line with the final position of the steel strip. This ramp consisted of two 4-in. I-beams 40 ft. long stiffened and made into a welded truss by the



HAULING LINE which draws steel-plate strip to upper anchorage is reeved through pulley on timber frame lashed to roof of cylindrical bins 97 ft. high.

addition of I-beam cross members and bar diagonals. The hauling rope drew the strip from the stock pile on the ground up the ramp and across the concrete slab until the fore end of the strip had advanced several feet beyond the edge of the lower roof. At this point the advance of the strip was halted to permit attachment of auxiliary supporting devices required in the erection.

When erecting the under strips by means of track cables, it was necessary to employ some device which would hold the strips on the cables. This need was met by attaching the steel strip at two points along its length to flat steel plates which ran on the track cables. The flat steel plates, or skids, rested on the cables and were secured to them by free-running U-bolts underneath the plates. The steel strip was fastened to each skid plate by bolted clips which gripped the edges of the strip. One of the skid plates was clipped to the steel strip near the fore end, and the second skid was used at about the center of the strip.

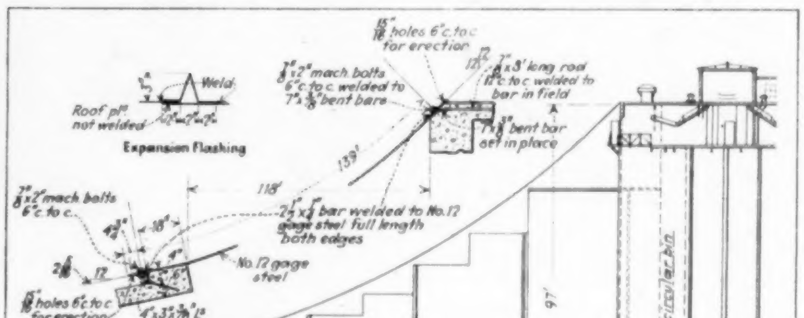
When erecting an intermediate strip which overlapped the two adjacent strips, no supporting cables were needed. The contractor found wood planks about 8 ft. long to be the most satisfactory means of supporting an intermediate strip safely on the adjacent strips during erection. Before starting erection of an intermediate strip, workmen assembled a set of seven or eight planks across the opening at the lower end of the roof slope, with the ends of the planks resting on the two under strips. As the overlapping strip was drawn upward, hoisting was halted at intervals of about 20 ft. to permit workmen to clinch these planks to the edges of the plates with double-headed nails. The planks traveled up the roof slope with the steel strip and supported it until it could be tack-welded to the underlapping adjacent strips.

Anchorages at the upper and lower ends of the suspended roof were provided with ⅞-in. bolts on 6-in. centers. At each end of a welded strip was a double row of bolt holes, an outer row for the erection yoke and an inner row for the anchor bolts. As a steel strip was drawn upward, it was anchored first to the bolts at the lower end and then to the bolts at the upper anchorage. After the strip had been anchored at the upper end, the hauling yoke was disconnected and lowered to the ground to pull up the next strip from the stock pile.

When a strip raised on track cables had been anchored, workmen advanced up the strip by holding on to hand ropes and loosened the bolted clips, allowing the skid plates to slide to the lower end of the cables. After an intermediate strip had been raised and bolted at the anchorages, it was adjusted to correct overlap on the two adjacent plates and tack-welded at intervals of about 10 ft. along both edges before the supporting timbers were withdrawn.

FREE-RUNNING STEEL-PLATE SKIDS on track cables are attached to welded strip by bolted clips which hold strip on track cables during erection.

AT EACH ANCHORAGE, steel-plate strip is secured by bolts. In erection, strip is bolted first at lower anchorage. Reinforcing plate placed over bolts will be welded along both edges to roof strip.



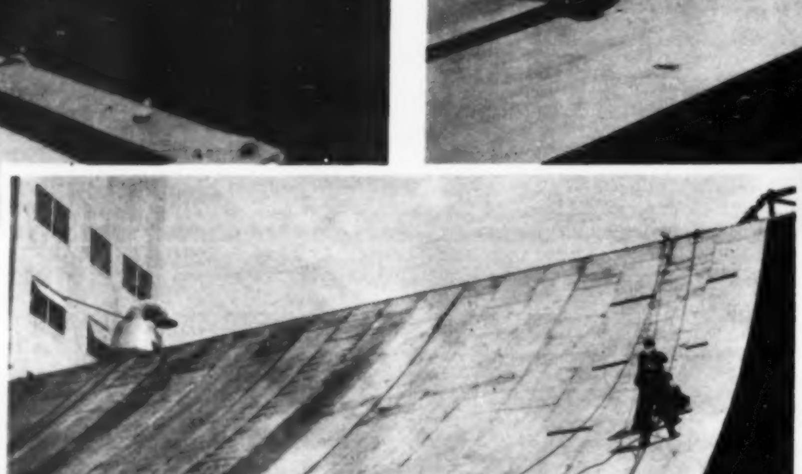
SECTIONAL ELEVATION of steel-plate roof and details of anchorage connections and expansion joint. Counterweighted A-frame resists overturning moment developed by roof at lower anchorage.

Track cables and their yokes were moved ahead by a simple procedure, after the strip which they were supporting had been anchored. One end of each of the two yokes was lashed to its anchorage, and the yoke was dropped and rotated about this lashed end to position for the next strip.

Tack-Welding—Because of the light gage of the plates (7/64 in.), it was necessary that the upper and lower plates be in close contact for welding. Otherwise, the arc burned away the upper plate, which did not have sufficient thickness to dissipate the heat. To assure the required contact for final welding, the contractor tacked the plates in advance at close intervals (about 4 in.).

INTERMEDIATE STRIP, overlapping two adjacent strips, needs no track cables during erection. Workmen attach wood plank supports at intervals as strip advances.

WELDER tacks overlapping strip to underlying plates at about 10-ft. intervals along both edges before wood plank supports are withdrawn.



TACK-WELDING CREW clings with help of hand ropes to steep slope of steel roof, completing preliminary spot welding prior to removal of planks.

Welding Equipment—Electric current for welding was supplied by eight 200-amp. 60/20-volt d.c. generator sets, four of which were Lincoln machines and four G.E. All the generators were driven by a.c. motors. Welding was done with either Lincoln Fleetweld or G. E. covered 5/32-in. electrode in 14-in. lengths. The coating of the electrode surrounded the arc with a vapor which excluded air, practically preventing formation of oxides and nitrides. This shielding effect of the vapor made it possible to use a higher voltage and a hotter arc than could have been employed with a bare rod, greatly increasing welding speed. As the vapor condensed, it deposited a slag cover on the hot metal which protected the weld during cooling. More than 7,500 lb. of electrode was required for the welding work, which included almost 55,000 lin.ft. of single-fillet joints.

Erecting and Welding Crews—A crew of five men took care of all fabricating operations. The two welders in the crew helped to handle plates as well as to weld them. Six men, in addition to the hoist engineer, comprised the erection force. One of the erectors did the primary tack-welding on the roof at 10-ft. intervals.

Final tacking at 4-in. intervals was performed by one two-man crew consisting of a welder and a helper. Two welders were engaged in final fillet welding of the joints. During the long days of the summer, the contractor made maximum use of the welding machines available by operating two shifts, the first from 5 a.m. to 1 p.m., and the second from 1 to 9 p.m.

Progress—Actual working time required by the crew of six men to erect the 72 140-ft. steel strips in one roof was 6 days (48 hr.). Adding the time consumed in making four moves of the sectional templet, the total period elapsed in erecting an entire roof was 9 days (72 hr.). On straight fillet welding of the joints on the roof, the operators averaged about 250 ft. each in 8 hr. One tack welder, with a helper, kept ahead of two fillet welders.

Flashing—Along the sloping edges of the roof, vertical 12-gage flashing plates 18 in. deep were welded to the roof edges. Each 18-in. flashing plate laps 8 in. under a counter-flashing girder about 2 ft. deep. The flashing plate and girder are not connected, the plate being free to move with the rise and fall of the roof caused by temperature changes or snow loads. The 8-in. lap is sufficient to take care of any movement. A welded steel-plate roof was laid from the counter-flashing girder to the curved walls of the circular bins and was bolted to cinch anchors in the concrete walls of the bins. The joint was sealed by pouring in roofers' pitch and by calking with oakum and plastic cement.

Anchorage Reinforcement—At the upper and lower ends of the suspended roof, where the strips were bolted, a reinforcing plate of $\frac{1}{4}$-in. steel was placed over the bolts and was welded along both edges to the roof plate. This added metal at the anchorage connection compensates for the reduced section at the bolt holes.

Supervision—In charge of the project for the Albany Port District Commission were Arnold G. Chapman, chief engineer, and R. L. Holt, construction engineer. H. G. Onstad, vice-president, was in general charge of design and construction for the James Stewart Corp. Paul C. Metz, superintendent, directed field operations for the general contractor. Erection and welding of the steel roofs were carried out under the direction of J. A. Klevens, president, and E. H. Methlie, vice-president, of the J. K. Welding Co., Inc., New York City.

Application has been made for a patent to cover the design of the suspended, self-supporting roof.

Helps to Successful Contracting

Sixth of a series of articles on applying business principles to construction and making profits by avoiding costly mistakes

By HARRY O. LOCHER

Contractor, New York

VI—Cost-Keeping and Records

A NEW office man had come on the job. He had the reputation of being a wizard with figures. It soon developed that he was entitled to the distinction. A system which had served reasonably well in keeping a check on costs was soon displaced by an intricate and bewildering method, unintelligible and of no practical value to anyone.

Accurate costs serve three vitally important purposes: First, they show, from day to day, whether work is being done at a gain or loss, and act as a constant spur to more efficient and economical operation. They prevent that often heard lament, "We should have kept closer track of that item." Second, accurate, dependable costs are an invaluable aid to safe and intelligent bidding. There is no safer bid information than your own carefully kept costs and records as a basis. Third, few jobs are completed without a few or many claims for additional compensation, for extra work, for changes in plans, for unforeseen contingencies not provided for in the contract.

Pay For Extra Work

UNLESS accurate costs have been kept from day to day, reimbursement for extra work is difficult and sometimes impossible to collect. In connection with extra work, a daily diary or record should be carefully and faithfully kept. As much detail as possible should be recorded, particularly all verbal agreements and instructions, with names of those present at the time of such agreements and instructions. On one big contract the fact that the contractors had allowed the owner access to all their carefully kept costs, had kept a precise, day-to-day record of all instructions and agreements, with names of those present at the time, and had recorded details as to all disputed items, resulted in their receiving a court award which saved them from a tremendous loss.

A contractor asked a young engineer what he thought was the best way to arrive at safe bid prices. His answer was, "Get two or three expert estimators and let them figure around for a week or so. Then let some old time contractor go over the job. He'll come back and say so and so is worth so much, and so and so, so much, on through the list of items. What he says will likely be nearer right than the figures the estimators arrive at."

Here we have two extremes—and extremes are most always unsound. An expert estimator's figures without practical experience and knowledge are not safe—he must have the "feel" of things, and relate his costs with doing the job before he is on safe ground. On the other hand the practical man with experience and knowledge who walks over a job and then comes in and says with imposing assurance that so and so is worth so much, on down the entire list without, perhaps, ever putting pencil to paper, is just as unsafe as the theoretical estimator without practical experience. Mix 'em up. Their combined knowledge is valuable. Good, practical construction men know how much certain shovels can handle under certain conditions, how much drills will do, how much material they can break with a certain amount of powder, etc., but many of them do not know how to figure, or what to include for administration, overhead costs and depreciation. Here is where the engineer or estimator comes in.

A certain contractor who, when low, was usually far below the next low bidder, and who always demanded regular and precise field costs and then guessed with little or no concern as to what administration, overhead, obsolescence and depreciation were costing him, wondered why each job finished up and found him with little more than a constantly accumulating lot of depreciated and largely obsolete equipment to show for his efforts.

Depreciation

THERE are some contractors who maintain that maintenance and upkeep provide for depreciation and even obsolescence. Nothing is further from the truth. Imagine for a moment a paving mixer, a dragline or shovel built in 1910, in competition with modern equipment. A certain shovel built in 1904 is still operating intermittently in a Pennsylvania quarry. This means you can keep 'em up, but how would this old-timer stack up in keen competition with a spanking, up-to-the-minute 1932 model? It would be just too bad. It is no exaggeration to say that up-to-the-minute equipment is the greatest cost-lowering factor in present-day construction work.

Of course, there are some exceptions to this condition, but they are so few and so obvious that they are readily recognized by thoughtful construction men. Some men who have been superintendents for years have no remote conception of what it costs to do certain or any items of work. It does not seem logical that a man who shows little or no interest in costs, particularly superintendents, walking bosses, foremen and others in authority, could be men from whom could be expected the most economical results.

"Remember those grim and relentless profit-killers, Depreciation and Obsolescence."

It is almost unbelievable how little some field construction men know about costs, and how little interested they are in them. How is it possible for men, who are directly responsible for costs in the field, to be right up on edge unless they are interested in or know something of what their work is costing? To many foremen, laying off or putting on more men is their only recognition of lower or higher costs and many of them are not concerned in this! In so far as economical results are concerned, it sometimes happens that putting on men may ultimately lower costs, and laying off men run costs up.

"It is no exaggeration to say that up-to-the-minute equipment is the greatest cost-lowering factor in present-day construction work."

One foreman complained that the superintendent had put half again as many men in his crew as he needed, overlooking the fact that this particular job should be done before cold weather when it would cost several times as much to do, even with additional men. There is no undue labor or hardship in keeping simple and accurate cost records on contract work. When the cost system departs from simplicity and common sense it also parts company with accuracy and destroys the interest of the average man in it.

Responsibility for Costs

THE main trouble in keeping accurate, dependable costs on the average size contract job is that usually no one man is solely responsible for the information. Accuracy is difficult to obtain when foremen and mechanics turn in carelessly made out reports and when this data is supplemented by general information gathered by the timekeeper from the foreman as he passed by. Then, in the office, others put their impressions and conclusions upon the information turned in. Due to this helter skelter, hit-or-miss method, rock excavation which might have had a field cost of 80c. per yard is shown as costing \$1.15 per yard, and concrete which really cost \$7 per yard is shown as costing \$5.90 per yard. These are only imaginary illustrations, but they are happening in actual practice every day. If they are wrong for the day, they are wrong for the month and for the entire job. Some one man should be made responsible for costs and he should circulate around the job, keeping a check on the distribution of men, the quantity of work being performed and the amount of materials being used. He should be able to do this work in a deliberate and unhurried manner, having help when needed. His work is the life blood of a contractor's business.

A cost system can be too involved and too intricate. On a certain job the men would jokingly say that the cost man knew the cost of flapjacks per dozen, and the hourly cost of 40-watt light bulbs, but it was an actual fact that on this job, due to the intricacies and infinitesimal lengths and ramifications of the cost figures, no remote idea could be gathered as to what it was really costing to take out rock excavation or place concrete. This cost system had been carried away beyond the point of practicability, and resulted in a sort of banter from the men, rather than valuable information which was seriously considered.

Here again is where the young engineer fits in. With the coaching and help of practical construction men, added to his own technical knowledge, he makes an ideal cost man. He should give his time to it, all of it, if the job is big enough to require all of it, and if the job is bigger than he can handle alone in an efficient and thorough manner he should be given help. With cost-keeping his only duty, he could move about the work and get accurate checks on

where the labor was being used; he could compute the volume of each class of work done daily; he could keep an accurate record of what materials were used each day; costs of certain work on which claims might arise could be carefully recorded, along with the proper explanatory matter as it occurred from day to day. Of course a job could be small enough not to require full time for one competent man, but the point which should be stressed is that a competent man should be in charge of costs, and that he should have the time to do his work in a deliberate, careful, unhurried manner.

Daily Information

A COST system worthy of the name should keep a contractor informed, from day to day, as to just what each item is costing. Here is the real value of costs. Unbelievable as it may seem, there are contractors who do not know until their work is completed what the detailed costs were—and maybe not then, or ever. As one of this type used to say, "I go in with so much and come out with so much; the difference is what I made or lost." Don't laugh. Some contractors who think they are keeping costs (a maze of figures which mean nothing) are on no surer ground than the man mentioned above who went in with so much and came out with so much, more or less.

There is no mystery in a cost system. It's simply a careful getting together of figures and placing them where they belong, by a very earnest, conscientious, capable man who does his work as it should be done, and has it up to the minute and available for practical guidance and safeguard every day. The essence of any cost system is its accuracy and its ever-ready, day-to-day availability. In your costs do not overlook overhead, administration, which includes bond premiums, insurance premiums of all kinds, interest, taxes, office and traveling expenses. And remember those grim and relentless profit-killers, Depreciation and Obsolescence. They work by day and by night. They carry on during rainy days as well as during fair ones. When you are idle, they work, and you pay the bill. In the winter time they are in your yard still gnawing away at your bank account. Your only protection against these profit killers is to include them in your "costs." Unless you do, some day you will find yourself with nothing but a collection of strange looking old contraptions, known at one time as equipment that was "all right," a lot of memories of the "good old days"—and little else.

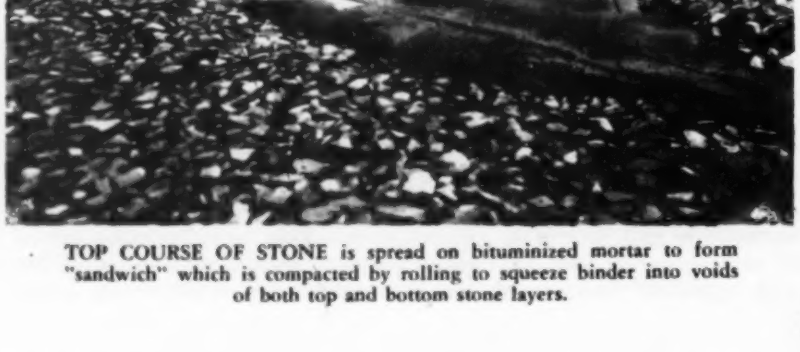
NEXT MONTH: The seventh article in Mr. Locher's series will discuss "Equipment."

"Sandwich" Type of Road Built With BITUMINIZED CEMENT

"SANDWICHED" between upper and lower courses of crushed stone, a mortar layer of sand and bituminized cement, a recent development of German origin, has been introduced in the United States as a bidder for building durable roads at low cost. In this type of construction the mortar binder is squeezed, by rolling, into the interstices of both the top and bottom courses of crushed stone, producing an impervious, non-skid, mosaic stone surface.

As described by T. A. Pearson, of Fred T. Ley & Co., Inc., contractor, of Springfield, Mass., in a paper before the annual convention of the American Road Builders' Association, the cement for the sandwich type of mortar-bound macadam is a standard portland cement the grains of which, during the process of manufacture, are thinly coated with bituminous material. This treatment retards the time of hardening and setting of the cement mortar, which remains workable and pliable long enough to provide for thorough compaction by rolling. The bitumen-coated product, according to Mr. Pearson, is not materially affected by temperature changes (thus minimizing pavement cracks), is water repellent and produces a road that may be opened to traffic immediately after the final rolling. The material, known as T.R.C. (Temperature Resisting Cement) is manufactured in this country by the Medusa Portland Cement Co., under license from the T.R.C. Corporation, which controls the patent rights.

INCLINED CHUTE from rear end of 3-yd. transit-mixer distributes bituminized cement mortar on bottom course of crushed stone, where it is spread by hand.



TOP COURSE OF STONE is spread on bituminized mortar to form "sandwich" which is compacted by rolling to squeeze binder into voids of both top and bottom stone layers.

The procedure in building a road bound with the bituminized cement mortar is as follows:

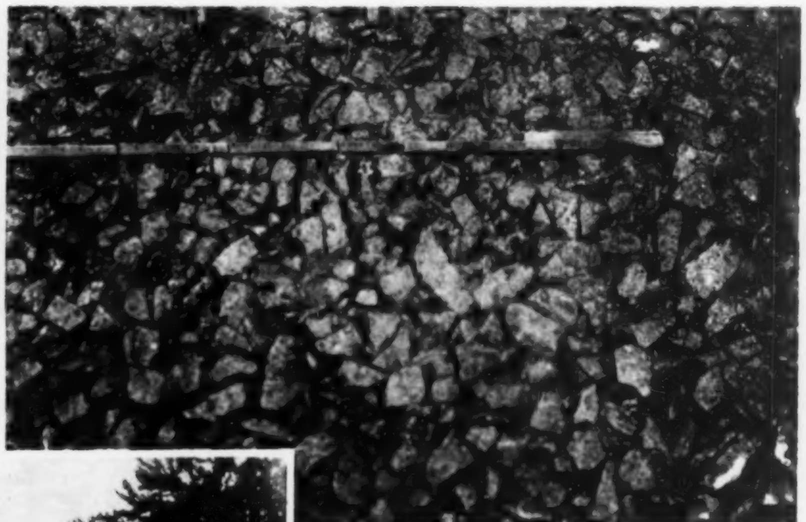
A $2\frac{1}{2}$-in. layer of irregular stone from $1\frac{1}{4}$ to $2\frac{1}{4}$ in. in size is laid on the sub-base and lightly rolled. Over this layer of stone is spread $1\frac{1}{4}$ to $1\frac{1}{2}$ in. of T.R.C. mortar, composed of 1 part of bituminized cement to $2\frac{1}{2}$ parts of sand, by volume. On top of the mortar course is spread another $2\frac{1}{2}$-in. layer of stone similar to the bottom course. The entire mass

is then rolled with a 12- to 15-ton roller until both courses are thoroughly penetrated and the mortar binder is thoroughly compacted. The variation in the thickness of the mortar is dependent upon the voids in the stone, and the binder should be of such thickness that when the mass is thoroughly compacted no mortar should show over the top course of stone, as it is preferable to have the mortar penetrate to within $\frac{1}{8}$ or $\frac{1}{4}$ in. of the top of the road surface. If, however, due to uneven spreading of mortar, the mortar should show over the surface of the roadway, it should be thoroughly broomed until the face of the stone is exposed.

Over the rolled surface is then broomed a grout coat, which fills all the voids between the faces of the stone and leaves a thin seal coat over the stone itself. Into this seal coat are thrown $\frac{1}{4}$-in. chips or sand, as desired, and after the water has been repelled from the mortar, the surface is again rolled with a 6- to 8-ton tandem roller for the purpose of embedding the $\frac{1}{4}$-in. stone or sand in the seal coat.

WIRE BROOMS are employed to distribute seal coat which binds stones of top course.

SEAL COAT is applied to surface after preliminary rolling has compacted stone "sandwich" layers and mortar binder.



OPEN FACE SURFACE, with mortar binder coming to top of stones, prevents skidding by motor cars.

HEAVY ROLLER of 12 to 15 tons weight causes mortar to penetrate into top and bottom stone layers.

The seal coat, in a minimum of 8 to 14 days under traffic, will start to throw off and, depending upon the amount of traffic, will in a few weeks be entirely thrown off, so that the finished surface of the road will have a mosaic appearance, similar to the open macadam surface which is now being extensively used. The seal coat is merely a temporary wearing coat to give the top stone a chance to be thoroughly set in the mortar binder before it actually takes wear.

The reason for naming this type of road mortar-bound macadam, instead of cement-bound or concrete, Mr. Pearson pointed out, is that it gets away entirely from pre-mixed concrete or cement penetration principles of laying, taking advantage of the fact that the initial set of the mortar is delayed sufficiently by the application of bituminous material to make possible the use of the macadam and not the concrete principle of laying.

With the penetration method, using pre-mixed concrete of standard cement there is time for only about $1\frac{1}{2}$ hr. rolling, because on most jobs the initial set starts in from 2 to $2\frac{1}{2}$ hr. after hydration. By the addition of bituminous material to the cement, however, the initial set is delayed for about 8 hr. It is, therefore, possible to continue the rolling operation from 12 to 15 hr. after the material is laid, thus giving ample time to shape the surface for riding quality. In addition, even though 28-day strength does not develop with the material until from 100 to 120 days, the road is available for immediate traffic without injury to the surface.

Except for the use of a small transit mixer for the bituminized mortar no equipment other than that used for ordinary macadam construction is necessary. The transit mix, Mr. Pearson points out, is the best method of mixing and transporting the mortar material, allowing the mixing process to continue as long as possible.

In using T.R.C. cement as a mortar binder it must be remembered that because of its repelling of water the material will require from 3 to 5 min. mixing to produce a sufficiently workable mortar. The water content can be left entirely to the repellent quality of the cement, as the material, as soon as it is dumped on the roadway, will immediately repel excess water which will come off absolutely clear.

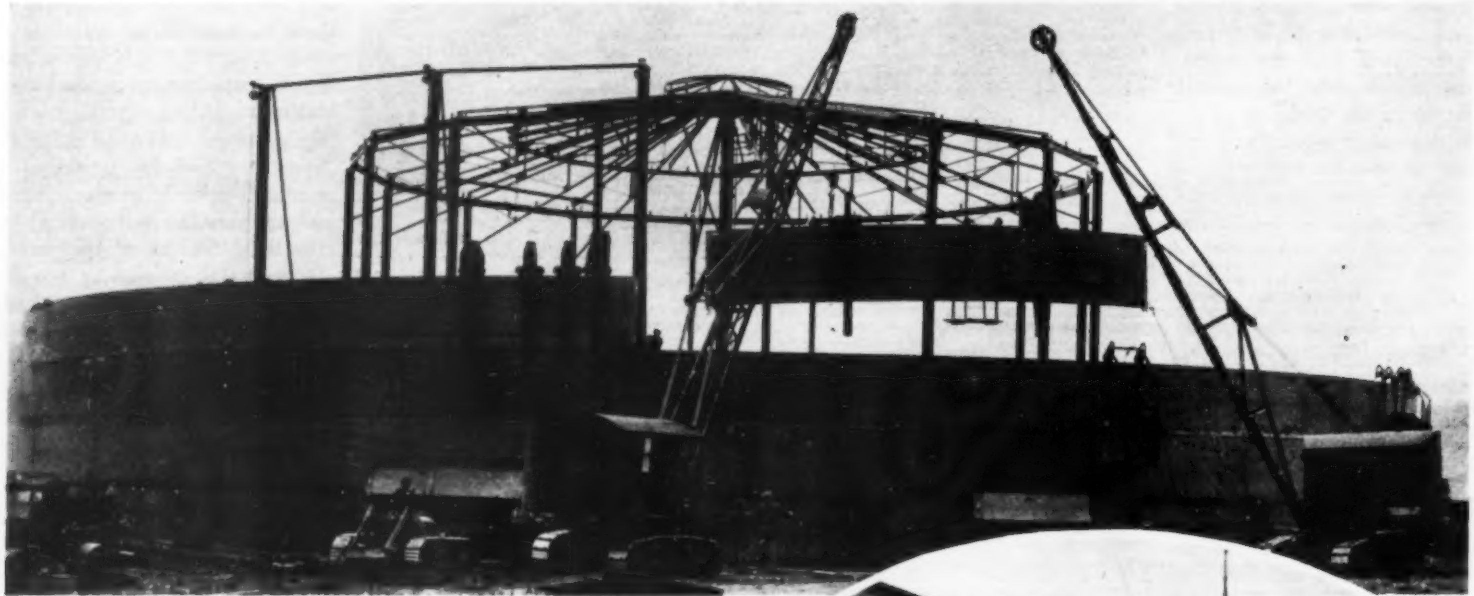
In this country lengths of bituminized-mortar-bound macadam highway have been constructed at Great Barrington, Mass., (1,300 lin. ft., 20 ft. wide), at Hampden, Mass. (2,000 lin. ft., 20 ft. wide), and elsewhere.

As an indication of the cost of this type of construction Mr. Pearson presents the following figures for expense of materials per square yard for a road 4 in. thick.

Cement (@ \$3.50 per barrel), $\frac{1}{2}$ bag, 43.5c.; sand (@ \$1.20 per cubic yard) 0.04 cu. yd., 4.8c.; stone (@ \$1.25 per ton) 0.25 ton, 31.25c. Total for materials, 80c. per square yard of 4-in. thick road.

The construction at Hampden, Mass., was a town work-relief project, utilizing a maximum of local hand labor. The mortar was batched at Springfield, 10 mi. distant, and hauled to the job in 3-yd. transit mixers. The amount of water employed in the mix was 6 gal. per bag of cement, which produced a mortar of satisfactory consistency. The mortar was applied to the stone base course by an inclined chute and was hand spread with wooden scrapers. The seal coat of mortar was brushed into place with steel brooms.

The Hampden job was done under the direction of L. O. Howlett, town supervisor of roads, by Fred T. Ley & Co., Inc., contractor, for whom M. J. Collins was superintendent.



SPECIAL JAW GRAPPLES *(above)* on a pair of P&H crawler cranes place steel plates, weighing up to 4 tons, in position for arc-welding on Milwaukee's new 6,000,000-gal. water storage tank. Tank, 165 ft. in diameter and $37\frac{1}{2}$ ft. high, required 700 tons of steel. Thickness of steel sheets varies from $1\frac{3}{16}$ in. for bottom course plates to $\frac{1}{2}$ in. at top. Steel erection and welding were done by A. O. Smith Corp., of Milwaukee, using ten gasoline-powered P&H Hansen welders. Tank roof, also arc-welded, is supported by structural steel framework.

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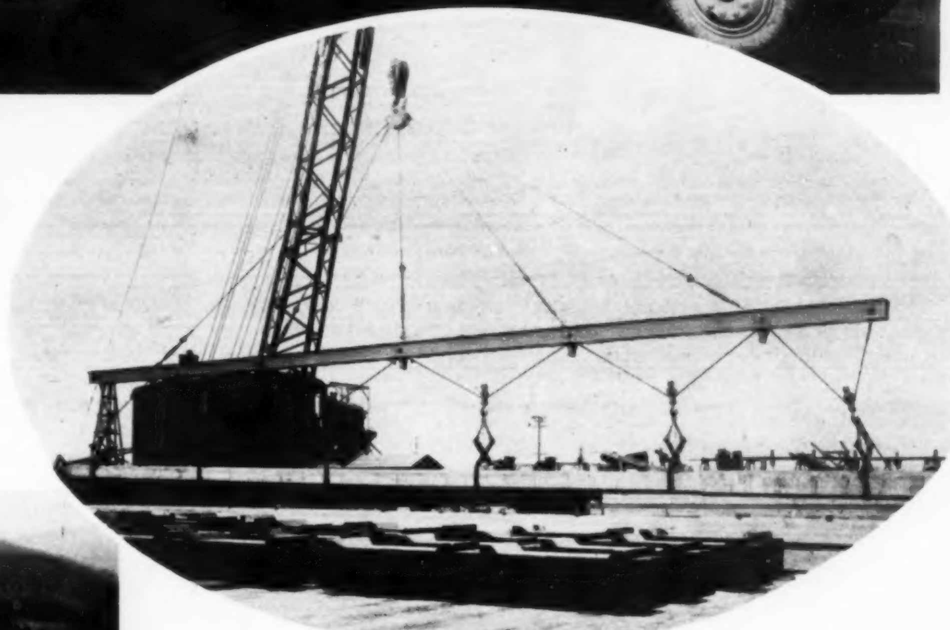
Getting Down to DETAILS

FINISHING MACHINE for 2-ft. concrete emergency sidewalk on structural steel curb of New Jersey highway viaduct (described in January issue of CONSTRUCTION METHODS) is pulled forward by cable from hand winch. Steel screed resting on curb flange strikes off concrete surface.

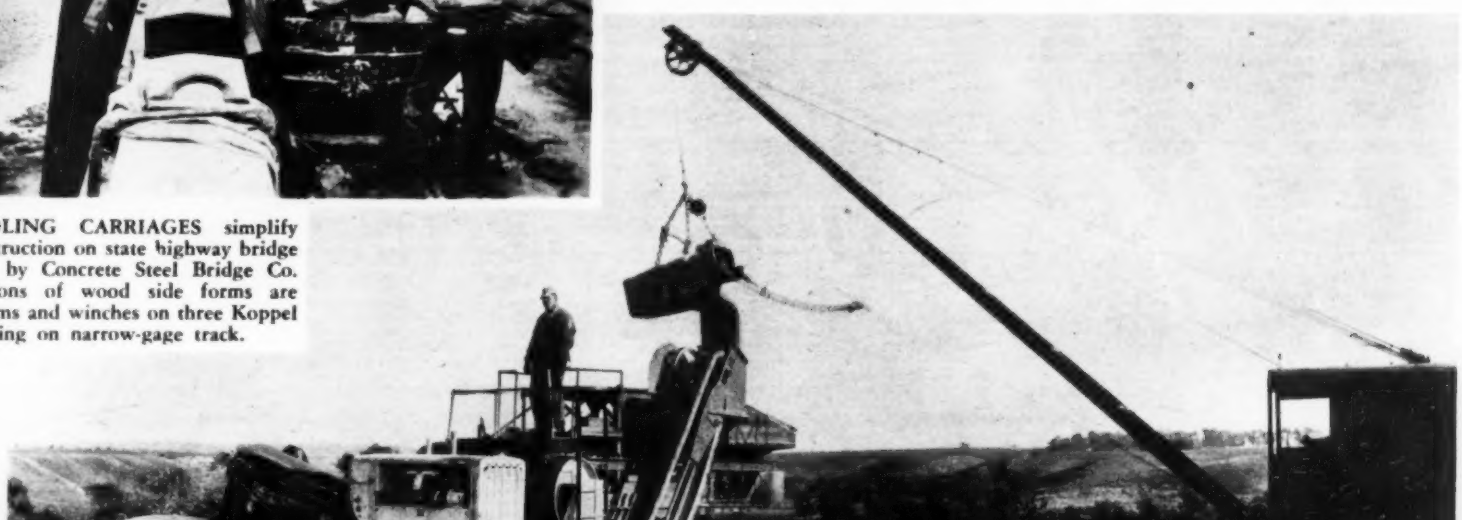
BELT CONVEYOR BUILDS LEVEES. Link-Belt anti-friction system, comprising 1,000 ft. of mobile, track-mounted conveyor, places earth for Dixie Construction Co. on 1,200,000-cu.yd. contract at Sherard, Miss. In borrow pit two 2-yd. draglines feed belt through traveling grizzly which breaks down lumps of "buckshot" clay. Discharge is regulated by bridge-mounted swinging boom.

TRANSFER PLANT for concrete paving work shifts proportioned batches of sand, stone and cement from batch truck to truck-mixer. Outfit, using covered belt conveyor, developed by Jaeger Machine Co., allows batch trucks to be added as haul increases, keeps investment for truck-mixers at minimum by limiting their haul to 1½ mi., and imposes 100 per cent load factor on all units. On road job with batching plant at beginning of contract, truck-mixers would lay first 1½ to 2 mi. of pavement. Then, transfer plant would be set up and moved ahead every other day, requiring additional trucks for batch haulage but holding down the number of truck-mixers required.



SIX POINT EQUALIZER handles long concrete bearing piles used in foundation work for marine terminal built by Los Angeles Board of Harbor Commissioners. G. F. Nicholson is harbor engineer, and major contracts on the $1,250,000 project are held by Pan-Pacific Piling and Construction Co. Merritt-Chapman & Scott Corp. and McClintic-Marshall Corp.

FORM-HANDLING CARRIAGES simplify guard rail construction on state highway bridge at Hyner, Pa., by Concrete Steel Bridge Co. Fifty-foot sections of wood side forms are handled by booms and winches on three Koppel trucks riding on narrow-gage track.



PORTABLE GRAVEL CRUSHING AND SCREENING PLANT produces 90 cu.yd. of material per hour for Richard Paul of Fort Dodge, Ia. This compact Pioneer trailer plant, comprising bucket elevator, crusher, screens and belt conveyor for loading trucks, is operated by built-in Caterpillar gasoline power unit.

A Day on the Job at

HOOVER DAM

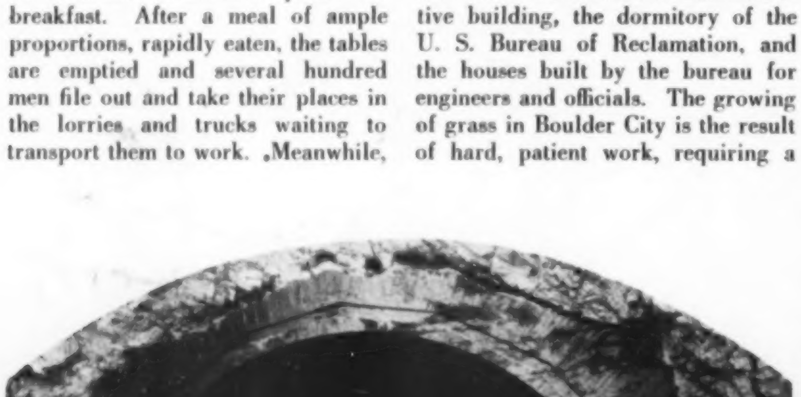
By J. I. BALLARD
Pacific Coast Editor of Construction Methods

ROCK SCALING CREW, working on steep sides of canyon 550 ft. above level of Colorado River, is equipped with safety ropes and slings.

LET'S take a rapid trip over the Hoover Dam project and inspect construction progress at the time when the Colorado River was diverted around the site through the 50-ft. diameter concrete-lined tunnels in the canyon walls. The trip will include Boulder City, construction capital of Nevada, a visit to the river diversion operations, canyon wall scaling, spillway excavation and other activities. Without stopping long at any one place and passing up the gravel pit, the trip can be made in a day.

At Boulder City the morning whistle turns you out at 6:20 a.m. Before you can dress for the chilly desert morning, with a temperature around freezing, the line at the big mess hall has already begun to form. At 6:30 the doors are opened for breakfast. After a meal of ample proportions, rapidly eaten, the tables are emptied and several hundred men file out and take their places in the lorries and trucks waiting to transport them to work. Meanwhile, from other parts of town, the crews are augmented by hurrying groups from the individual houses occupied by the married men of the Six Companies' organization. The transport fleet leaves promptly at 7 o'clock.

Around Town—A brief swing around town discloses the principal commercial establishment of the community, the Six Companies' general store containing every department the name implies. In addition, there are small stores, eating places, garages and a movie theatre. These are grouped in the central part of town and a few blocks east is the elementary school building and the municipal building housing the postoffice and city administration. Looking north from these buildings, you see a desert miracle—green lawns and shrubs around the administrative building, the dormitory of the U. S. Bureau of Reclamation, and the houses built by the bureau for engineers and officials. The growing of grass in Boulder City is the result of hard, patient work, requiring a humus base on the sterile desert sand and subsequent generous applications of fertilizer and water. The parking areas along all the streets have been set with trees.



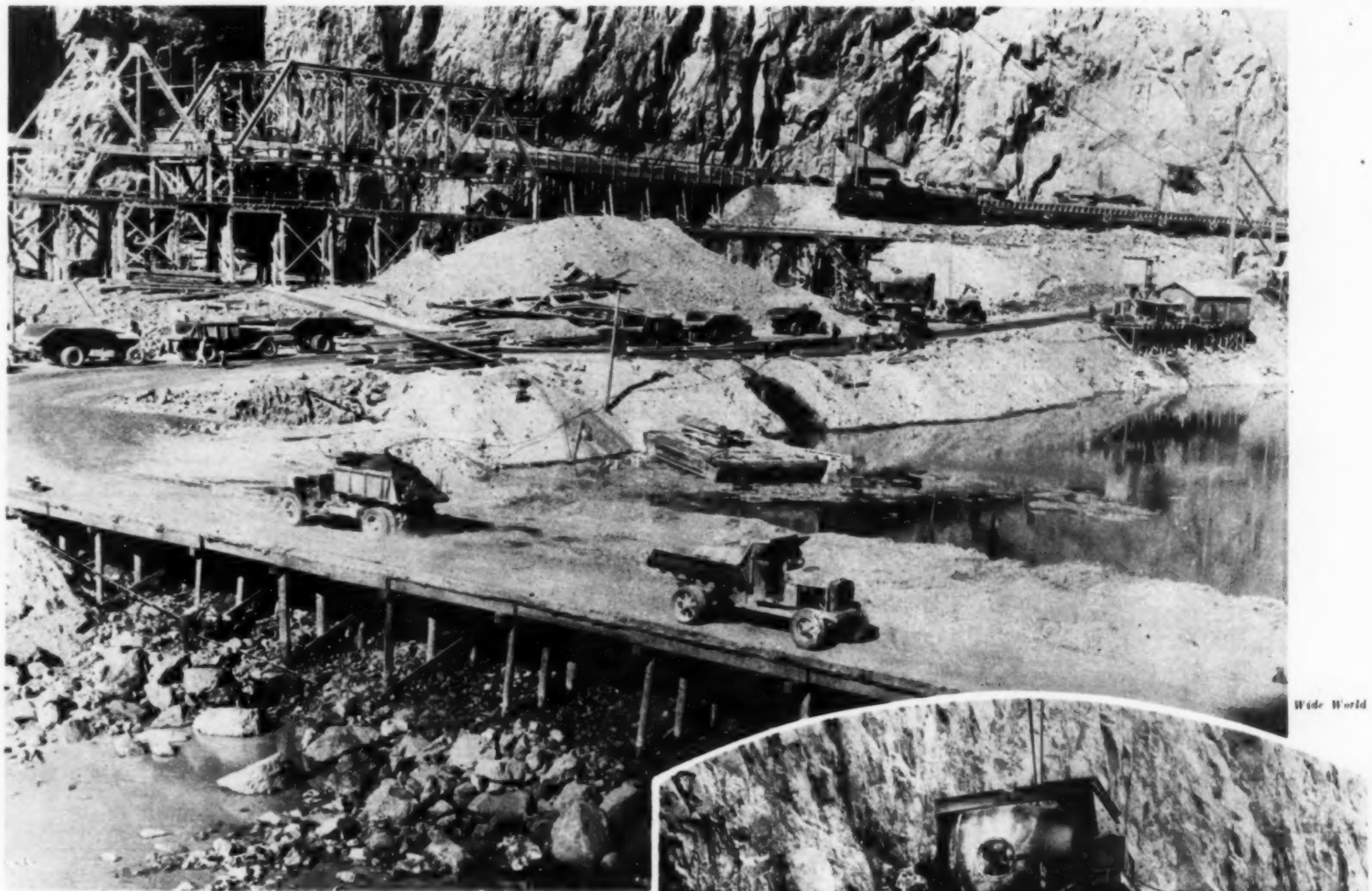
TIMBER RAMP allows trucks to enter and leave 50-ft. diameter concrete-lined diversion tunnel over top of temporary cofferdam at intake end.

Turning to look south through the blocks occupied by the Six Companies' employees, the aspect is different and there is only an occasional spot of green to break the gray monotony of desert sand in yards and parking strips. Here lawns are entirely the result of individual time and money. The constant wind moves the fine sand continually and many of the gutters are curb full.

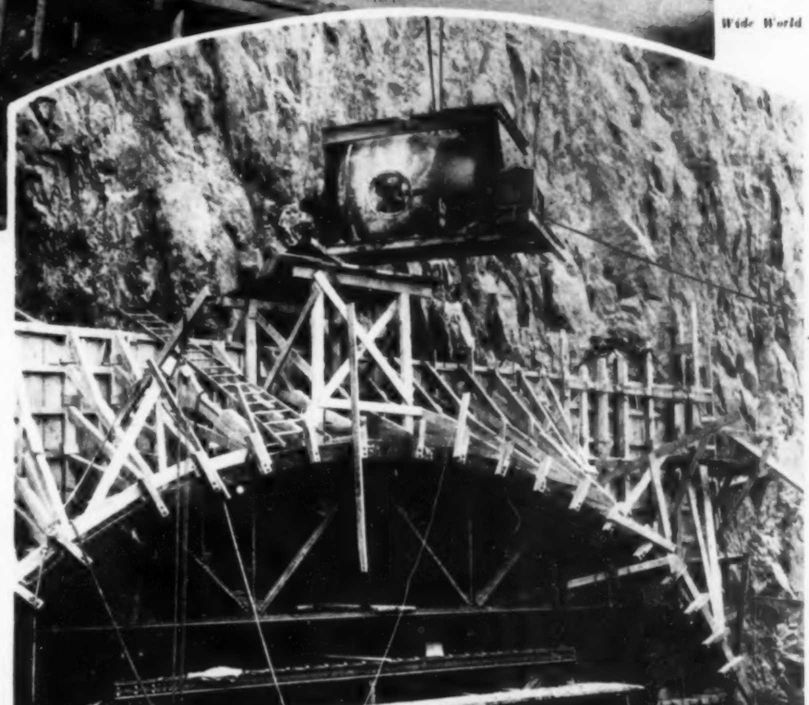
En Route to River—Leaving town for the river, the route follows the main government highway for a short distance and then turns off on to a well-oiled construction road leading to the upper end of the canyon. On the left, going down the Hemenway Wash, is the contractor's railroad and stock piles of 500,000 cu.yd. of prepared aggregate above the high water storage level. These stock piles will be used for the upper section of the dam after storage has flooded the site of the screening plant. Getting closer to the river, the gravel plant can be seen about ½ mi. north. Close at hand, on the south side of the road borrow pit, earth and gravel for the upstream cofferdam are being excavated. This pit has been provided with a complete loop of railroad track and an electric shovel is loading trains.

Entering the canyon, the road runs between the rock wall and double-track railroad on fill material. Trains move out of the canyon with excavated material to be wasted in the mouth of the wash and refilled from the borrow pit with material for the cofferdam. Other trains move into the canyon with loads of prepared aggregate, cement and other materials. Here is the river camp, which houses about 400 men who prefer this location to Boulder City; it includes mess hall and hospital. At the mouth of the canyon is the guard station which is an effective barrier to the tourist; it cannot be passed except in official cars or with the proper credentials.

A short distance beyond is the low-level concrete mixing plant with its present installation of four 4-yd. mixers and provisions for an additional pair, when required. This extensive concrete manufacturing plant includes pits for dumping trainloads of aggregate, a conveyor belt to the bunkers and the batching and mixing plant itself. Bulk cement by the carload is pumped to storage above the



TEMPORARY DIKE of truck-dumped earth and rock is placed in Colorado River bed to divert flow toward Arizona side during construction of upstream cofferdam. In background, note steel truss railway bridge and material tram.



AERIAL CONCRETING. Crane boom picks Rex 4-cu.yd. moto-mixer body off truck chassis and raises it to point of discharge into arch section of diversion tunnel portal lining.

plant. At this location are one of the main compressor plants, the government testing laboratory and a truck oiling and repair shop.

The concrete plant is in operation on a restricted output because the bulk of the tunnel lining has been placed. Trucks with 4-yd. agitator bodies receive the contents of each 4-yd. mixer. The road for trucks and other vehicles at present leaves the mixing plant and passes through a 1,000-ft. tunnel which ultimately will be used by the railroad in reaching the actual damsite. At present, the railroad line has been extended a short distance further into the canyon at a lower elevation on a fill beside the river. The downstream portal of this tunnel opens up on to a scene of concentrated activity with a view which takes in the four upstream portals of the diversion tunnels, the upper cofferdam site, the transferring of excavated material from truck to train and other work.

Work in Canyon — Preparations had been completed for carrying out the river diversion, affording an excellent opportunity to see the work and the canyon before diversion and the plan for by-passing the river through the tunnels.

On the right-hand (Nevada) canyon wall in the foreground are the portals of diversion tunnels Nos. 1 and 2, protected from the river by an extensive deposit of tunnel spoil which provides ample area for trucking, form building and field offices. Loaded trucks are emerging from tunnel No. 1 with rock spoil loaded by shovel about 2,000 ft. in, where the shaft up to the Nevada spillway is being driven. Immediately downstream on the canyon wall a crew of steel erectors is building a steel truss bridge which will carry the railroad line, in its final location, from the tunnel just traversed into the second railroad tunnel required to reach the actual damsite. The agitator-body concrete trucks are entering and leaving the portal of tunnel No. 2 directly under this bridge erection work. Some lining operations are still in progress in this tunnel, although it is open for travel and is being used as the main road between the activities at the upstream and downstream portals.

From the river channel straight ahead comes the roar of trucks as the work of excavating and filling for the upper cofferdam progresses. To permit work to be started in this area before river diversion was completed, the contractor built an earth- and rock-fill dike by end dumping from trucks down the center of the river channel to the lower end of the cofferdam site and then connecting back to the Nevada canyon wall. This temporary barrier turned the Colorado River into the Arizona side of its channel and permitted the start of work on half the cofferdam site.

Excavation started immediately on the removal of 250,000 cu.yd. of river silt and loose deposits which must be stripped to firm consolidated material before the earthfill can be started. Shovels and a 5-yd. electric dragline, moved down temporarily from the gravel pit, are loading the constant stream of trucks which move in and out of this hole and transfer their loads to the waiting trains at the nearby loading dock. Excavation is deepest along the upstream toe where specifications require that a row of steel sheet piling reach to rock and connect at the top with the 6-in. reinforced concrete slab on the upstream face. The dam is of usual earthfill design with a 3:1 slope on

the upstream face and a 4:1 slope on the downstream. Earth is deposited from trucks, after rehandling from the trains and placed in 12-in. layers, sprinkled and rolled to compaction.

Immediately upstream from this cofferdam site, in the foreground, is the temporary timber trestle bridge across the river which the contractor has used extensively for truck transportation, although it has been replaced two or three times as the result of high water. The permanent steel suspension bridge, above high water level, is available at other times but is not as convenient. Preparations are under way for blasting the concrete arch cofferdams in front of the upstream portals of the two Arizona tunnels. The surface of the river is flowing about 10 ft. above the invert of the tunnels.

About noon on the next day, it is learned, the arches will be blasted out and the river turned into the tunnels. As soon as the tunnel portals have been opened by the blast, trucks will begin dumping rock and earth from the temporary trestle to complete diversion of the stream. This will make the entire cofferdam site available for work.

The next feature of the trip is a thrilling ride through the cavernous 50-ft. diameter, concrete-lined diversion tunnel on the Nevada side. It is a fast trip of almost a mile to the downstream portals.

Rock Scaling—Climbing the long, winding 10-per cent grade, the construction road finally connects with the permanent government highway to the rim and the route swings back to the canyon and the observation station. Gazing over the parapet, about 700 ft. above the river, interest centers on the spectacular work of the scaling crews on both canyon walls, removing loose rock and preparing for actual excavation of the abutments. This work is the most hazardous and interesting operation to watch on the project.

Suspended from ropes or working on narrow ledges, these crews start from the top of the canyon walls and work down, removing all loose rock and blasting away sections down to solid material. Although various schemes have been considered to do this work from staging or scaffolds, the method with safety ropes and slings has proved to be the most practical. Members of these crews are required to carry safety ropes with which to attach themselves to the permanent lines down the face of the cliff and all wear hard hats. Danger from rocks above is slight because all loose material is removed as the work progresses. Similar operations are under way in preparing the cuts in the canyon wall to provide bases for the four intake towers. This work is similar and the cuts are carried down on a ¼:1 slope for a maximum distance of 300 ft.

Scaling operations extend along the actual damsite, above the outlet valve houses and the power-house site. The crew working on the Arizona side is taken across the canyon on a cableway which eliminates about a 6-mi. additional ride down into the canyon and up to the opposite rim.

Spillway Cut—A short ride along the rim of the canyon permits inspection of the operations at the Nevada spillway. This immense rock cut 650 ft. long, and its companion spillway on the Arizona side, involved the excavation of about 625,000 yd. of solid rock by open-cut method. The spillways will be of side channel type and will be provided with a concrete overflow section to be fitted with four 100x16-ft. drum gates. Discharge from the spillways will be through inclined shafts 600 ft. long connecting with the two outside diversion tunnels, which will be used for carrying the permanent spillway discharge.

DEEP OPEN-CUT is excavated for Arizona spillway, which will discharge into inclined tunnel whose top has been holed through, as seen on spillway face.

IN COLORADO RIVER-BED work progresses on construction of upstream cofferdam. Electric shovel and dragline handle excavation. Material for fill, delivered by trucks, is spread by tractor-operated bulldozers and consolidated by sheepsfoot roller.

Cableways — At several locations on both canyon walls foundation work is under way for the installation of five 20-ton cableways, to be built by the contractor to cover all parts of the work from the spillways to the lower end of the power-house structure. In addition to these five new units, the present 12- and 35-ton cableways at the upstream and downstream portals of the diversion tunnels will continue in operation. For reasons of economy and maintenance the five cableways will be standardized on a 20-ton size. Beginning at the upstream end of the canyon, two parallel traveling cableways of 2,575-ft. span, with runways 700 ft. long, will cover the spillway structures, the outlet towers and the upstream section of the dam. The length of span for this upstream pair of cableways was necessary to reach the spillway structures which are several hundred feet back from the canyon rim.

Next, downstream, will be another pair of 20-ton cableways on 1,385-ft. spans which will be slightly radial in travel, with a head-tower travel of 500 ft. and tail-tower travel of 380 ft. This double unit will cover the dam from crest to downstream toe and also will reach the upper end of the power-house structure. The site for these cableways provided serious foundation problems, and a structural steel trestle was necessary to support the head tower on the Nevada side. On the Arizona side an extensive rockfill obtained from the spillway excavation will support the tail towers.

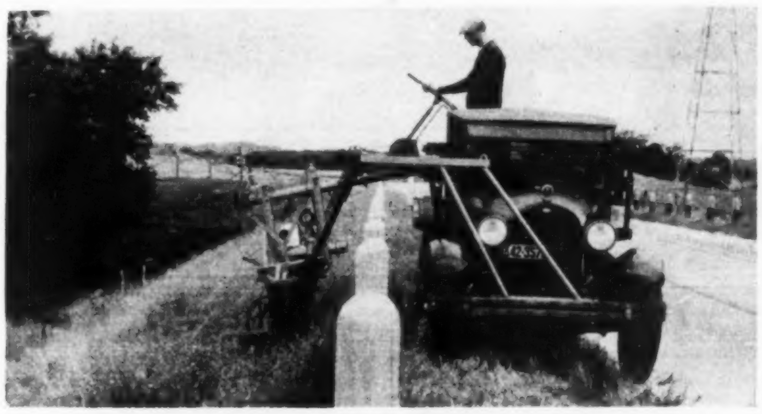
The last unit downstream will be a 20-ton radial cableway of 1,365-ft. span. The 98-ft. stationary head-tower on the Nevada side and the traveling tail-tower on the Arizona side will enable this cableway to cover the canyon area down to the 150-ton cableway under construction by the government for handling penstock pipe and heavy equipment. All cableways will be electrically operated, with control on the Nevada side of the canyon. They will be used extensively for the handling of excavated material in the canyon and the transporting of concrete and equipment. Skips of 12-yd. capacity will be used to handle the excavated material and the cableways will operate with 8-cu.yd. concrete buckets for placing concrete in the dam.

JOB ODDITIES

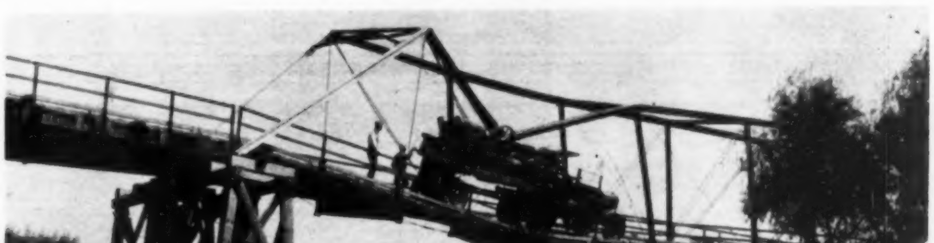
A Monthly Page of Unusual Features of Construction

DISHPAN REFLECTORS for night lighting have been devised by special crew of Six Companies Inc., for construction of the Hoover dam.

BIG STEEL PLAQUE, 18 ft. in diameter, is raised to place as decoration for wall of Radio City Music Hall, world's largest theatre, in Rockefeller Center, New York.

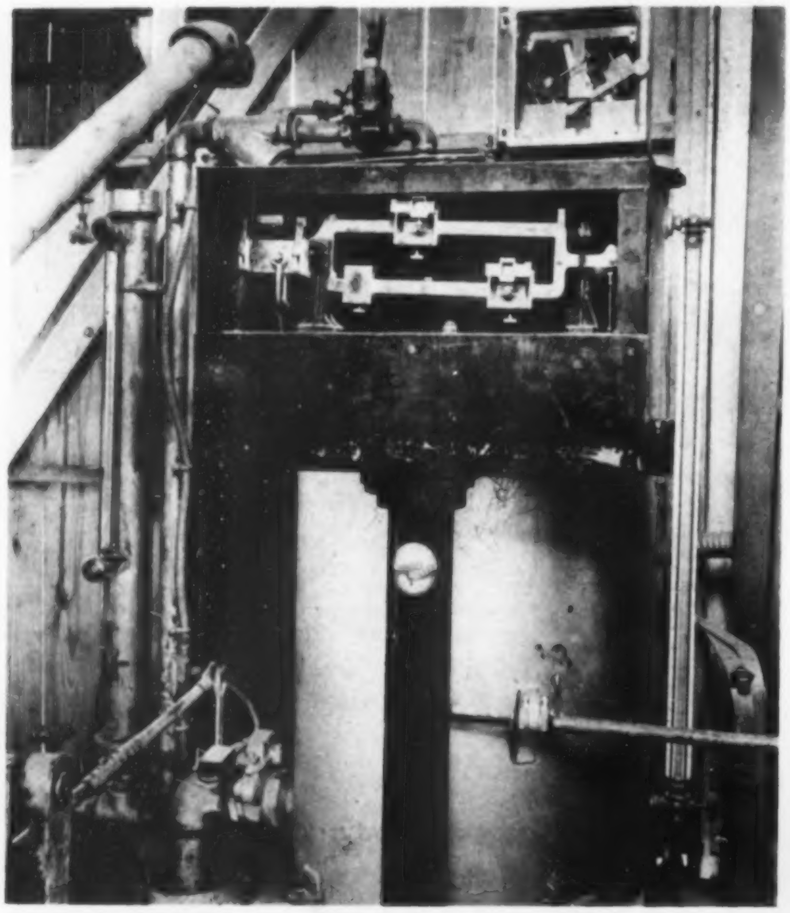


BOARDING-HOUSE REACH. Toro weed and grass cutter, rigged on Ford truck of Minnesota Highway Department, mows on either side of guard rail.



BRIDGE COLLAPSE DELAYED BY TRUCK. After one of the vertical posts of a light steel highway bridge in Texas had been struck by a loaded truck, the truss, starting to fall, was held up when its upper chord members wedged on top of the truck load *(above)* in such a way that the truck itself, acting in place of the damaged post, became part of the crippled bridge structure and complete failure was temporarily averted. After 24 hr., the truck owner, disregarding warnings, attempted to recover his machine by pulling it out with a winch on an adjacent span. When the truck was moved the top chord buckled, dropping bridge *(left)*, truck and five men.

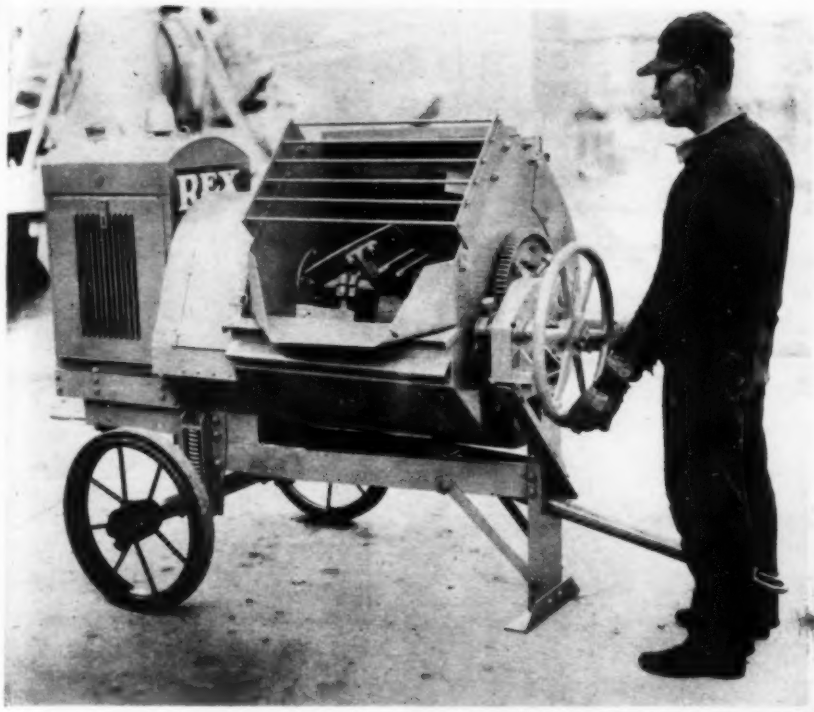
BALANCED DESIGN *(right)* for ¾-yd. crawler shovel and crane develops maximum capacity per pound of weight by utilizing stability and strength rather than bulk. Machinery frame is tilted toward rear, and all turntable machinery is grouped back of center pin so that it not only performs its operating functions but utilizes its own weight to counterbalance loads lifted. All-steel shovel boom and dipper stick, the latter, a 7-in. one-piece tube. Automatic dipper trip, standard equipment. Boom equipment interchangeable. End axle design is such that shovel dipper may be drawn in against crawler base to start digging cycle. All levers grouped within convenient reach of operator who has wide range of vision. Modern two-color streamline cab. Capacities, ¾, ½ and ⅜ yd. Weight, ¾-yd., 30,000 lb.; ½-yd., 23,000 lb.—Universal Crane Co., Lorain, Ohio.



NEW EQUIPMENT *On the Job*

AUTOMATIC WATER-WEIGHING AND MEASURING TANK for use with concrete mixing plants consists of cylindrical water tank mounted on platform scale equipped with two beams, both of which are graduated in gallons. Required number of gallons established by poise on upper beam. Deduction for moisture contained in aggregate obtained by setting poise on lower beam with number of gallons of water in aggregate. When inlet valve is opened by pushbutton, water flows into tank until weighing beam balances. When beam is level, valve closes. Water discharged from tank to mixer by hand or by mechanical operation with remote control.—Blaw-Knox Co., Pittsburgh, Pa.

TWO-WAY DUMP WAGON *(right)*, for hauling rock as well as earth, has heaped load capacity of 11 cu.yd. Turns in diameter of 22 ft., thereby eliminating necessity of rear-end dumping on most jobs. Equipped with 15-ton track wheels. Dumped by heavy-duty, two-stage hydraulic hoist of double-acting type. Heavy, coiled springs carry four corners of one-piece body and relieve all members from impact stresses of falling rocks.—Euclid Road Machinery Co., Euclid, Ohio.



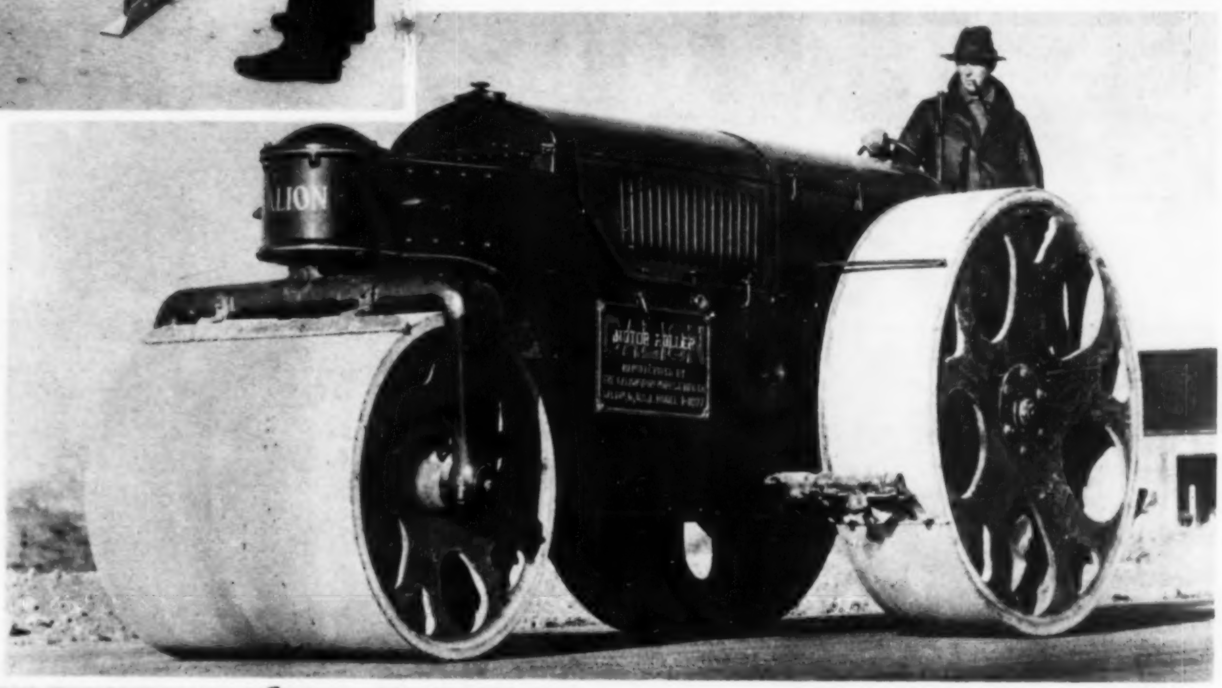
COLD PATCH MIXER of pug mill type *(left)* for handling either cut-back or emulsified asphalt. Equipped with built-in heater which is detachable and may be used for heating oil before mixing. Capacity, 4 to 6 cu.ft. of mixed material, depending upon the type of asphalt and aggregate used. Equipped with easy dump hand wheel for charging and discharging. Will mix batch of emulsified asphalt in 20 sec.; of cut-back asphalt in 45 sec. Powered by 2-cylinder, 8-hp. radiator or hopper cooled Le Roi engine, equipped with high tension magneto.—Chain Belt Co., Milwaukee, Wis.

PORTABLE LIGHT for emergency work where powerful, easily handled light is required. Weight, 23 lb., when fully charged. Produces 1,500 candlepower for 5 hr. on 1½ lb. of National 14-N.D. granulated Carbide. As more than 75 per cent of weight is on bottom, it is not easily tipped over.—National Carbide Sales Corp., Lincoln Bldg., New York City.

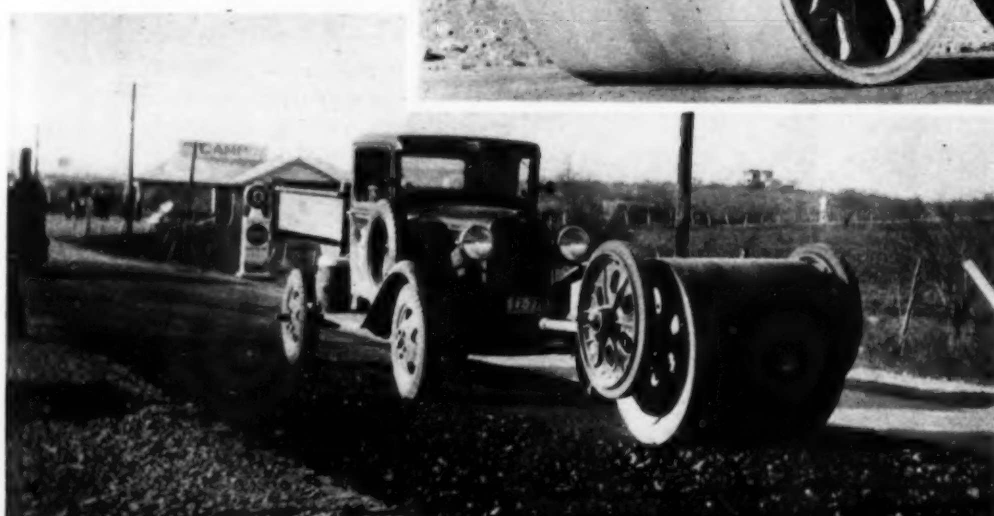
If You Want Further Information—

Within the space limits of this page it is impossible to present complete information about the products illustrated.

The manufacturers, however, will be glad to supply further details if you will write to them.



THREE-WHEEL, 6-CYLINDER, 10-12-TON MOTOR ROLLER *(right)* has speed of 6 mi. per hour and can turn in a 33-ft. circle or in an 18-ft. roadway by backing once. Front rolls mounted on spring-supported king pin. Spring-mounted engine and transmission which includes differential, bull gears and rear axle. One-man operation. Equipped with hydraulic steering device. Differential lock permits locking of both rear wheels, preventing slipping. Scarifier and sprinkler attachments available. Two sizes—10 and 12 tons.—Galion Iron Works & Mfg. Co., Galion, Ohio.



WHEELED ROLLER *(left)* for highway maintenance can be moved from one job to another on rubber-tired wheels by simply turning over tongue. Features: Eccentric axle construction cast of chrome nickel steel; cast-iron roller drum; structural steel frame; water tank and scrapers; Timken bearings; heavy wheels with solid rubber tires. Standard size, 36 in., weighing 100 lb. per contact inch, but can be obtained in weights up to 200 lb. Gross weight, 3,880 lb.—The Wheeled Roller Corp., P. O. Box 862, San Antonio, Tex.

MECHANICAL SPREADER *(right)* consists of spiral conveyor which receives concrete from side-discharge truck-mixer and distributes it across road. Hopper set on either side of spreader to receive concrete. Spiral also reversible. Spreader also may be used for distributing concrete which has been deposited on grade by boom and bucket of standard paving mixer. Adapted for striking off below forms for two-course work. Has forward speed varying from 12 to 40 ft. per minute and reverse speed of from 50 to 75 ft. per minute, depending upon capacity required. — Jaeger Machine Co., Columbus, Ohio.

Present and Accounted For—

A Page of Personalities

HEADS LICENSING COUNCIL. Olaf Laurgaard, city engineer of Portland, Ore., has been named president of the National Council of State Boards of Engineering Examiners. He is a graduate of the University of Wisconsin and has served with the U. S. Bureau of Reclamation on irrigation and power projects, with the Pacific Power and Light Co., on construction in the Yakima Valley and with the State of Oregon, as project engineer on irrigation works. After two years of independent practice as consulting engineer and a term in the Oregon Legislature, Mr. Laurgaard was appointed city engineer of Portland and has served to date in that capacity, having directed a public work program of about $55,000,000.

TO LEAD NEW YORK CONTRACTORS for second time. John J. Watts, vice-president and senior member of Mason & Hanger Co., Inc., and Silas Mason Co., has been elected to the presidency of the General Contractors Association of New York, an office he previously held in 1923. Mr. Watts, a native of West Virginia, has had a long and varied construction experience, including railroad and tunnel work, highways, industrial plants and public works. During recent years his firm has been outstanding in the field of subway building and subaqueous tunneling in New York, Philadelphia and Boston.

Among projects recently completed have been two shield-driven subway tunnels under the East River, New York, costing $22,000,000 and $12,000,000 respectively, the $7,000,000 vehicular tunnel under Boston Harbor and the $1,160,000 New Jersey pier foundations for the George Washington bridge over the Hudson River. During the World War Mr. Watts' organization completed the $20,000,000 Old Hickory powder plant for the U. S. Government in Tennessee, and the $6,000,000 cantonment at Camp Taylor, Kentucky. Established in 1827, the Mason & Hanger company ranks among the oldest construction organizations in the United States.

In addition to other activities Mr. Watts is president of Mason & Hanger Securities Corporation and partner in the brokerage firm of McClure, Jones & Co., of New York.

CITED FOR HIGHWAY SERVICE. Arthur N. Johnson, dean, College of Engineering, University of Maryland, is this year's recipient of the George S. Bartlett Award "for outstanding highway service." A pioneer in highway engineering in the United States, Dean Johnson served as state highway engineer of Maryland and of Illinois, was highway engineer of the U. S. Office (now the Bureau) of Public Roads, and consulting engineer to the Portland Cement Association. The award to Dean Johnson was made in January at the Highway and Building Congress in Detroit on the joint recommendation of the Highway Research Board, the American Association of State Highway Officials and the American Road Builders' Association.

PRESIDENCY FOR CONSTRUCTION ENGINEER. George C. Ward, formerly vice-president in charge of construction, is the new president of the Southern California Edison Co., of Los Angeles, for which he has had charge of construction involving an aggregate cost of more than $200,000,000. He has received honorary engineering degrees from the University of Southern California and from Oberlin College.

CITY'S BUSINESS ACTIVITIES will now claim part of the time of W. M. List, well-known railroad contractor of Kansas City, Mo., and head of the List Construction Co. Mr. List was recently chosen director of the Kansas City Chamber of Commerce. He is a past-president of the Associated General Contractors of Missouri.

CONTRACTORS: Mine Down This Shaft

1. Tilter $3\frac{1}{2}$
2. Mixer 5-S
3. Mixer 7-S
4. Mixer 10-S
5. Mixer 14-S
6. Mixer 28-S
7. Mixer 56-S
8. Mixer 84-S
9. Moto-Mixer 1 yd.
10. Moto-Mixer $1\frac{1}{2}$ yd.
11. Moto-Mixer 2 yd.
12. Moto-Mixer 3 yd.
13. Moto-Mixer 4 yd.
14. Moto-Mixer 5 yd.
15. Moto-Agitator $1\frac{1}{2}$ yd.
16. Moto-Agitator 2 yd.
17. Moto-Agitator 3 yd.
18. Moto-Agitator $4\frac{1}{2}$ yd.
19. Moto-Agitator 5 yd.
20. Moto-Agitator 7 yd.
21. Paver 27-E
22. Tower Paver
23. Pumpcrete Single
24. Pumpcrete Dual
25. Plaster and Mortar Mixer
26. Mortar Mixer No. 11
27. Speed Primer Pump 2″
28. Speed Primer Pump $2\frac{1}{2}$″
29. Speed Primer Pump 3″
30. Speed Primer Pump 4″
31. Speed Primer Pump 6″
32. Diaphragm Pump 3″ S
33. Diaphragm Pump 4″ O
34. Diaphragm Pump 4″ SC
35. Diaphragm Pump 4″ DO
36. Diaphragm Pump 4″ DC
37. Diaphragm Pump 4″ F
38. Sludge Pump—Single
39. Sludge Pump—Double
40. Road Pump—80-gal.
41. Road Pump—125-gal.
42. Saw Rig No. 3
43. Saw Rig No. 5
44. Cold Patch Mixer
45. Contractors' Elevators
46. Bulk Cement Plants
47. Belt Conveyors
48. Belt Idlers
49. Central Mixing Plants

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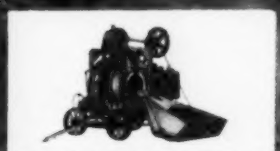
Yep, there's still money in contracting for the man who is properly tooled up to meet today's prices with today's bids on today's jobs.

The Chain Belt Company produces 49 complete and distinct machines for the contractor. Each one has a place where it represents a better way of doing work at lower costs:

Nugget No. 4

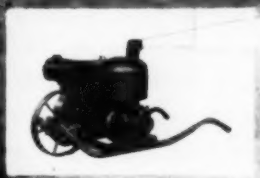


THE REX 10-S—Full 2-bag capacity, the Rex Water Control. Rex Shimmy Skip—7 second charge—7 second discharge—and quality in the Rex 10-S—the Bridge Builder's Special.

Nugget No. 44

COLD PATCH MIXER
Handles all mixes—20 second mix on emulsified asphalt—45 seconds on cut back—with positive and complete discharge and without balling up.

Nuggets No. 27-28-29-30-31
REX SPEED PRIMERS
2″-2½″-3″-4″-6″



SELF-PRIMING CENTRIFUGAL PUMPS
The Babies that Revolutionized the small pumping field. With their positive prime, and big capacity, these pumps have been outstanding in the contracting field since the first one was built. When the water gets dirty, and full of gravel—and the line leaking air—these Rex Pumps keep pumping water when others stop.

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THE MOST COMPLETE LINE BUILT

New kind of tractor tire cuts working time 30%

ZERO Pressure certainly is big news for contractors and road builders. Imagine adding 30% more traction—30% more power by simply putting this new kind of tire on your maintainers.

And that's only half the story. Tests prove that three maintainers on Zero Pressure Tires not only do the work of four on old style rubber tires, *they each use 18 to 20% less gasoline and oil doing it!*

Zero Pressures banish all problems of punctures, blow-outs and tire maintenance. They require no air pressure — they can't go flat. Zero Pressure Tires cost less — far less than pneumatics, yet they greatly outwear all other type tires.

Do you blame us for being enthusiastic? And remember, Zero Pressure Tires are no longer an experiment. They have proved themselves on the job — are paying big dividends on hundreds of jobs *today*. They are the one *sure* way of cutting operating costs — increasing profits right away.

Write, wire or phone The Truck and Bus Tire Division, Dept. Z11, of the B. F. Goodrich Rubber Co., Akron, O., now for complete information.

THEY CAN'T GO FLAT

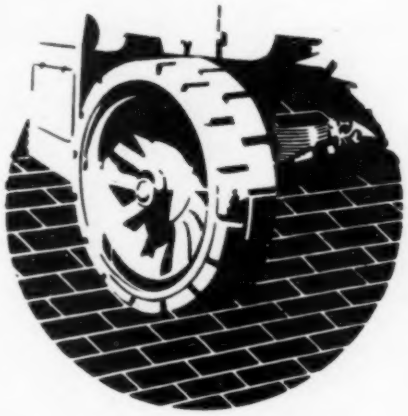
Zero Pressure Advantages: Greater traction — no punctures or blowouts—eliminates spinning—sinking. Saves gas and oil. Speeds up tractor operations. Gives uninterrupted, continuous service. Reduces tractor repairs—depreciation. Eliminates hazards of pneumatics—lighter than solids.

"Goodrich Zero Pressure Tires seem to excel even the lug wheel in their tractive effort," says Mr. C. D. Hibbard, of Port Snelling, Minn.

Goodrich *ZERO PRESSURE* Tires

Specify **Zero Pressure Tires** *on New Equipment*

RESURFACED WITH METROPOLITAN BRICK . . . CHOSEN ON ITS RECORD



FREEDOM from Maintenance Cost over a period of 24 years!

That was the reason why intersecting portions of Liberty Street and Broadway at Newburgh, N. Y. were resurfaced with Metropolitan Brick.

2½" Bessemer Fiber Lug Block was selected for this job, requiring approximately 39,000 square yards. This type of brick was chosen largely because it already had a 24-year record in this community for serviceability and freedom from maintenance.

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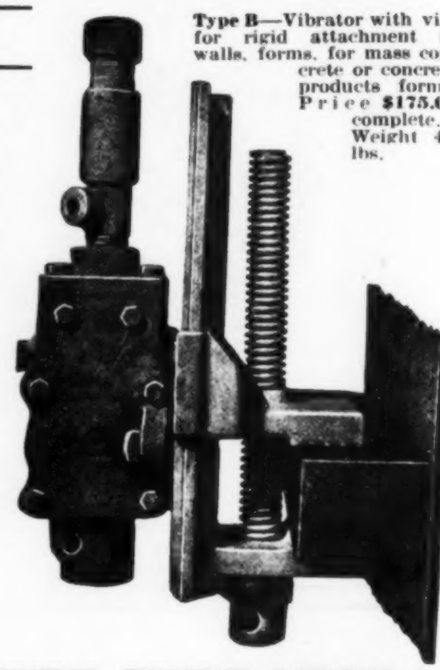

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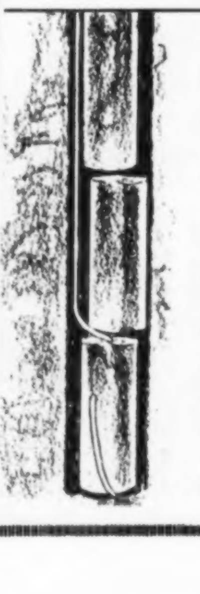

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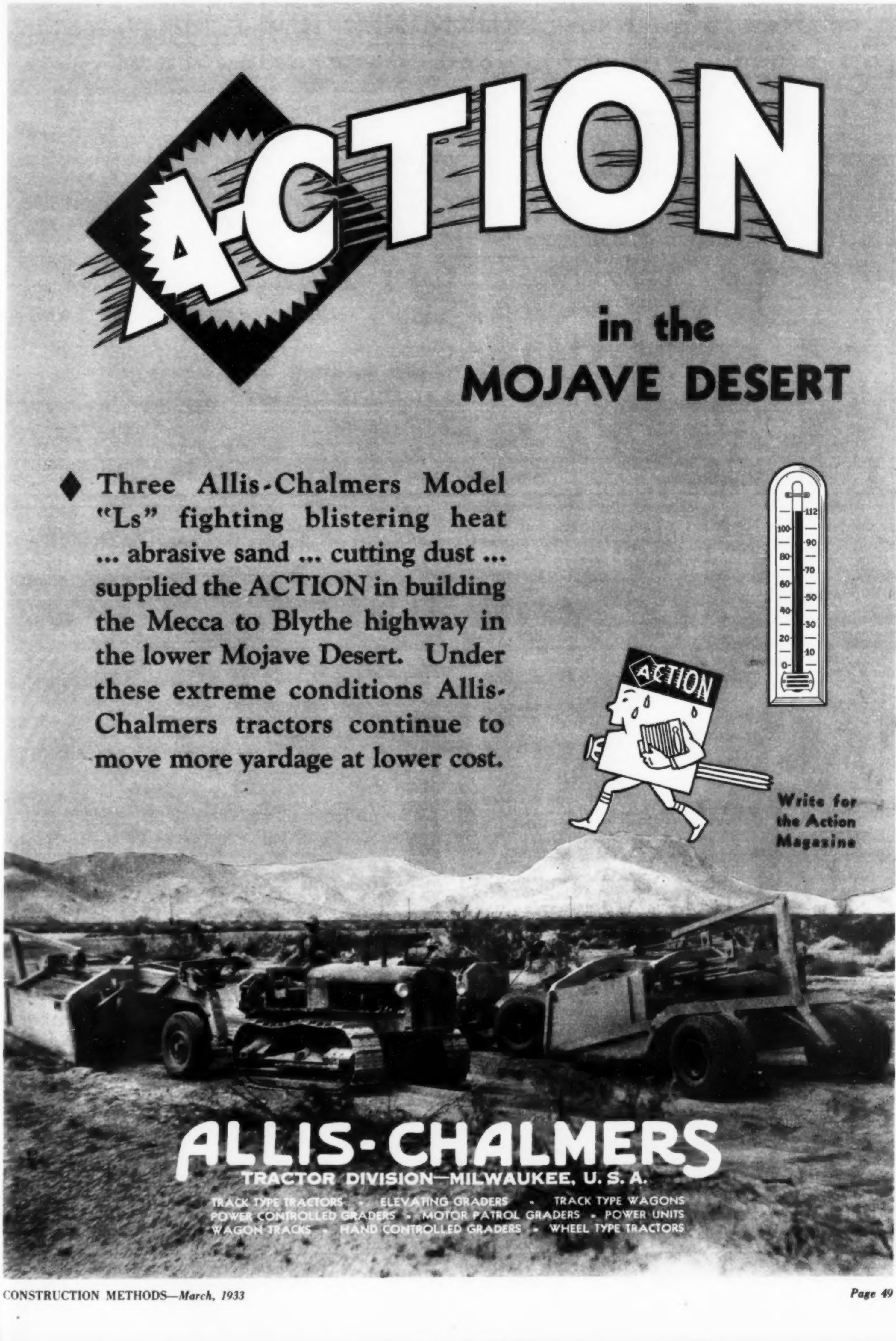
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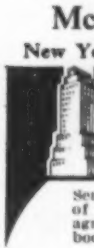

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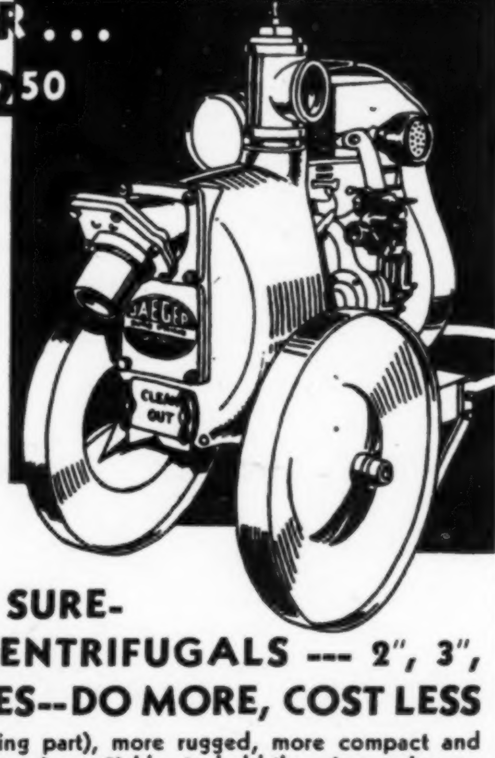

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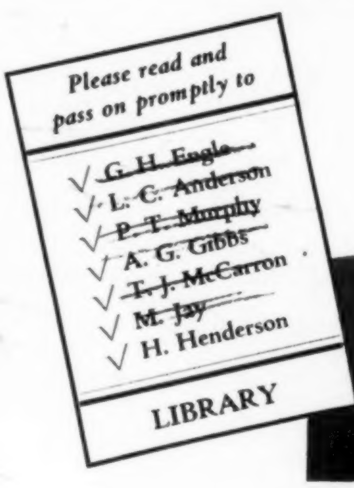

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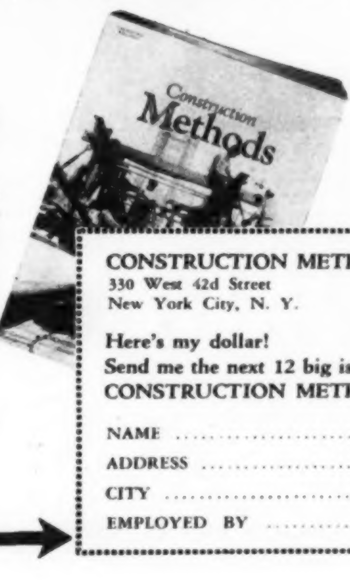

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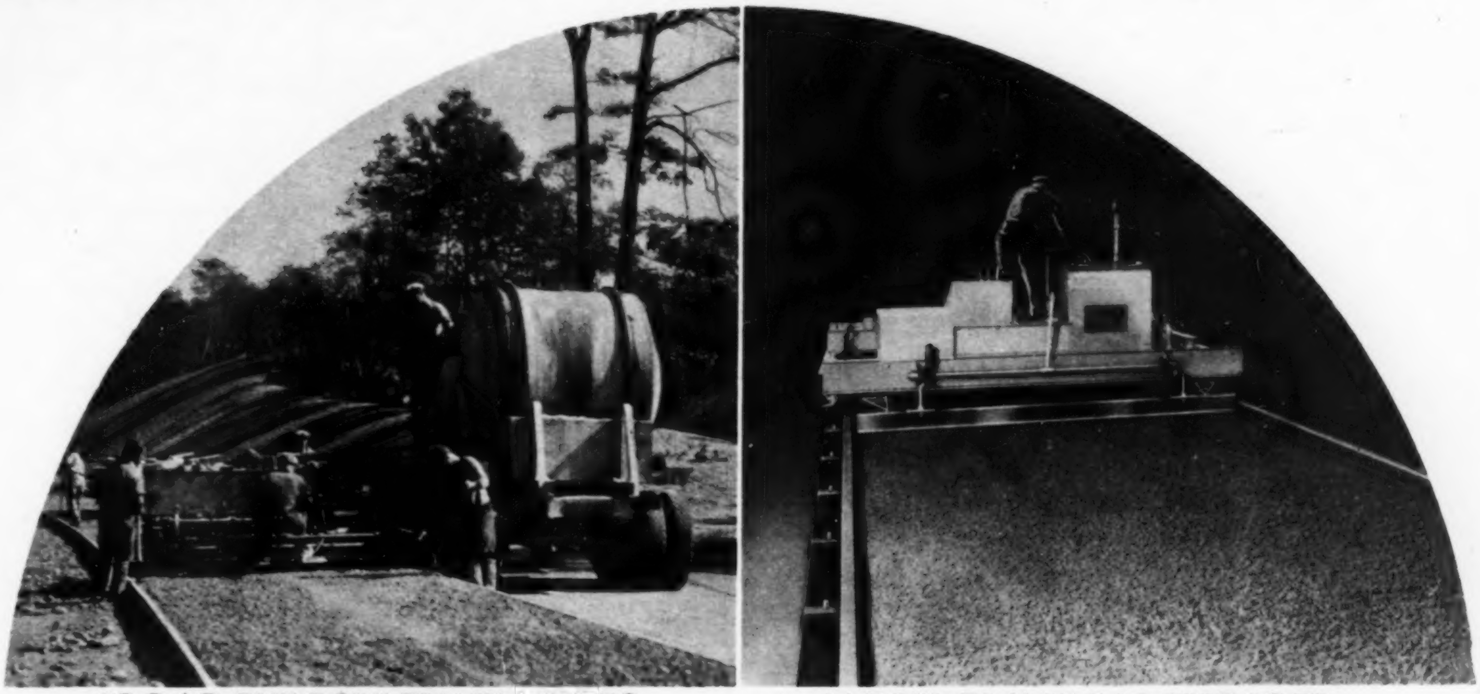

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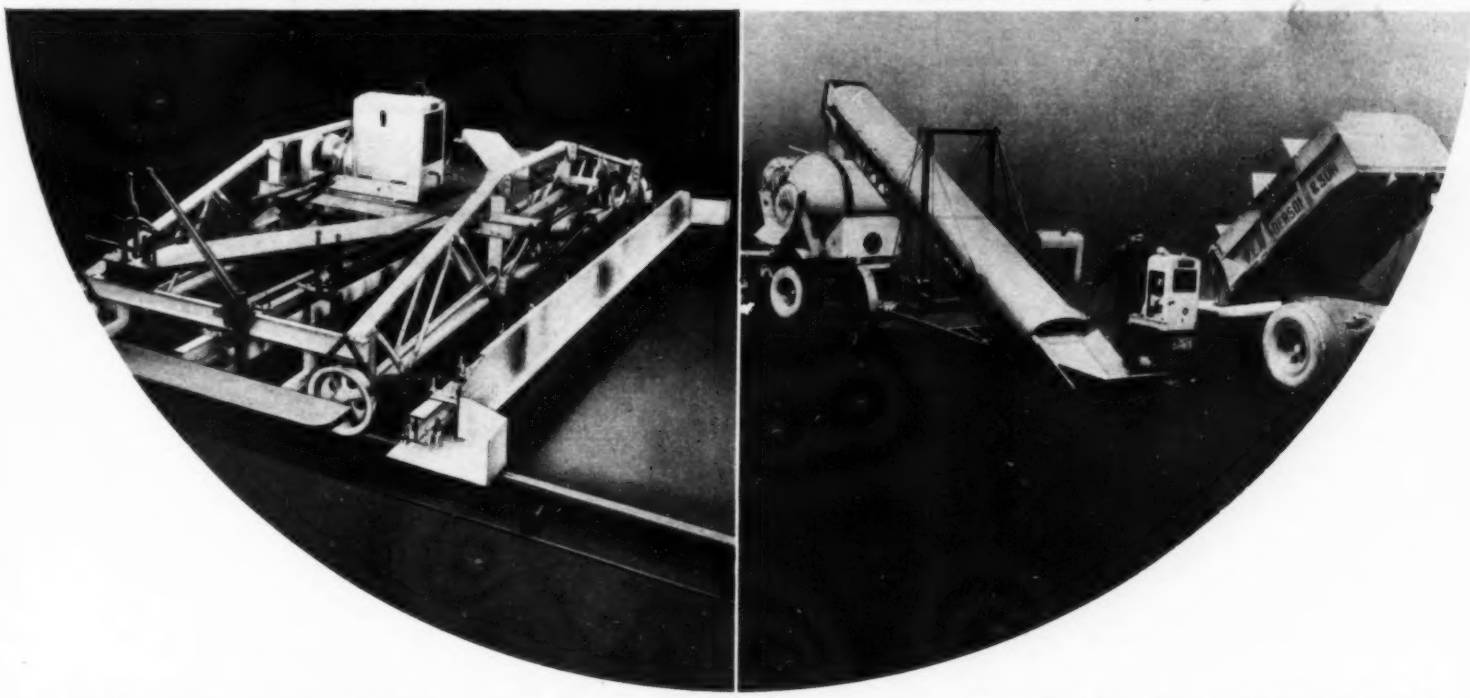

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